US009433437B2

(12) **United States Patent**
Kesten et al.

(10) **Patent No.: US 9,433,437 B2**
(45) **Date of Patent: Sep. 6, 2016**

(54) **APPARATUS AND METHOD FOR TREATMENT OF ETHMOID SINUSITIS**

(71) Applicant: **Acclarent, Inc.**, Menlo Park, CA (US)

(72) Inventors: **Randy J. Kesten**, Mountain View, CA (US); **Howard Levine**, Longboat Key, FL (US); **John W. White**, Menlo Park, CA (US); **Thomas R. Jenkins**, Alameda, CA (US); **Jessica M. Liberatore**, San Mateo, CA (US); **Jayakar V. Nayak**, Stanford, CA (US)

(73) Assignee: **Acclarent, Inc.**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/837,104**

(22) Filed: **Mar. 15, 2013**

(65) **Prior Publication Data**

US 2014/0276328 A1 Sep. 18, 2014

(51) **Int. Cl.**

A61B 17/34	(2006.01)
A61M 27/00	(2006.01)
A61B 17/24	(2006.01)

(Continued)

(52) **U.S. Cl.**

CPC ***A61B 17/3478*** (2013.01); ***A61B 17/24*** (2013.01); *A61B 17/12104* (2013.01); *A61B 2017/00331* (2013.01); *A61B 2017/12004* (2013.01); *A61B 2017/320004* (2013.01); *A61B 2017/3454* (2013.01); *A61F 13/20* (2013.01); *A61F 13/2022* (2013.01);

(Continued)

(58) **Field of Classification Search**

CPC A61B 17/34; A61B 17/1688; A61B 2017/1785; A61B 17/24; A61B 17/3415; A61B 17/3468; A61B 2017/3437; A61B 17/3478; A61B 17/12104; A61M 27/00; A61M 29/02; A61M 2210/06; A61M 2210/0618; A61M 2210/0681; A61M 2210/0687; A61M 2210/0693; A61M 29/00; A61M 25/04; A61M 2025/0226; A61M 2029/025; A61F 11/004; A61F 2/18; A61F 2/186; A61F 2210/0061

See application file for complete search history.

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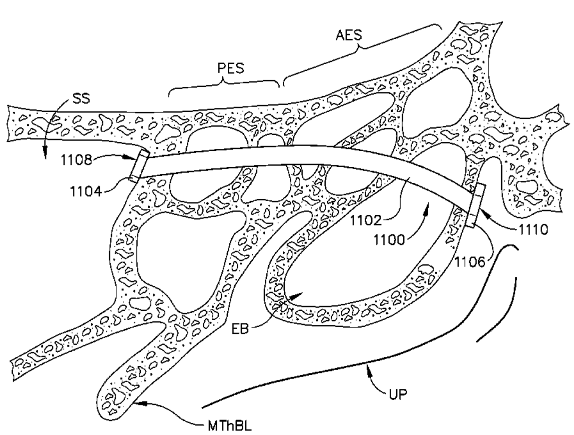
Primary Examiner — Adam Marcetich
(74) *Attorney, Agent, or Firm* — Frost Brown Todd LLC

(57) **ABSTRACT**

Fluid communication may be improved for an ethmoid sinus by installing a port or wick in the wall of the ethmoid sinus to provide a fluid passageway across the wall of the ethmoid sinus. Fluid communication for an ethmoid sinus may also be improved by inflating a balloon in a retrobullar space, remodeling the posterior wall of the ethmoid bulla to expand the transition area in the retrobullar space. In addition, a wall defining the retrobullar space may be pierced to provide a passageway for fluid communication.

8 Claims, 49 Drawing Sheets



(51) **Int. Cl.**

A61M 29/02	(2006.01)
A61F 13/20	(2006.01)
A61B 17/12	(2006.01)
A61M 1/00	(2006.01)
A61B 17/00	(2006.01)
A61B 17/32	(2006.01)

(52) **U.S. Cl.**
CPC *A61M 1/008* (2013.01); *A61M 29/02* (2013.01); *A61M 2210/0618* (2013.01)

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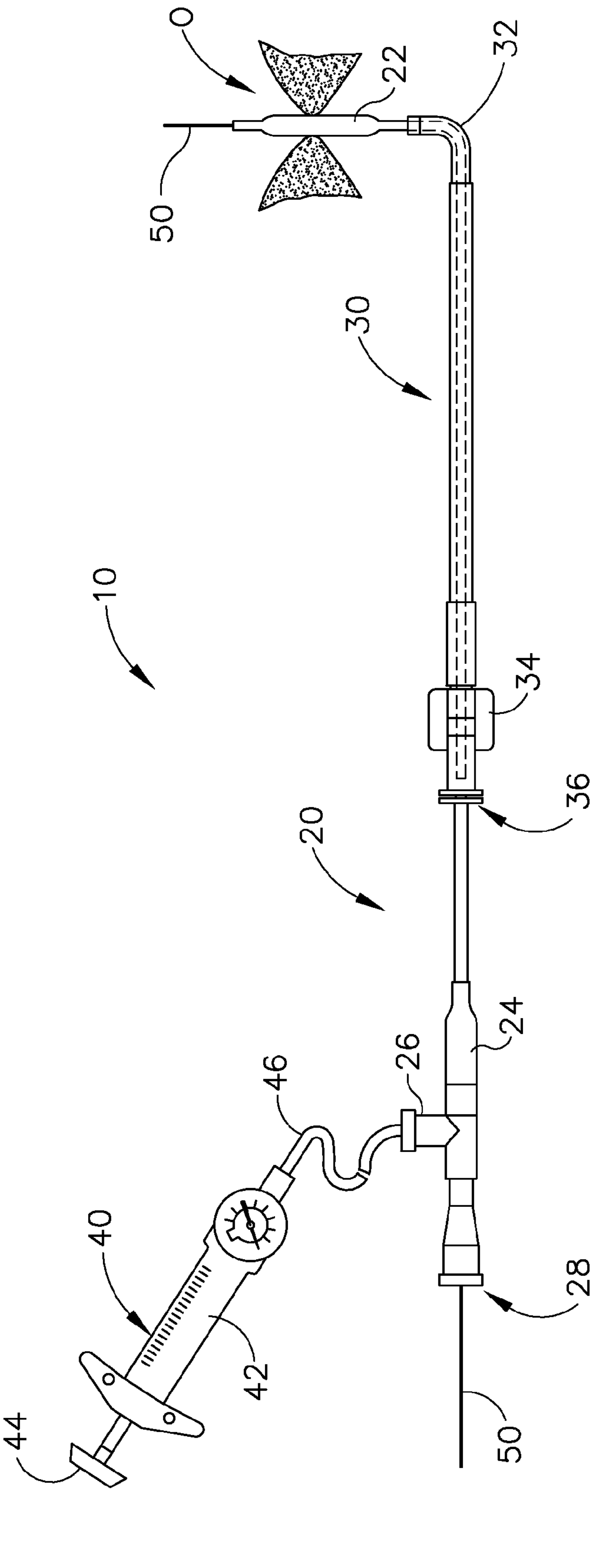

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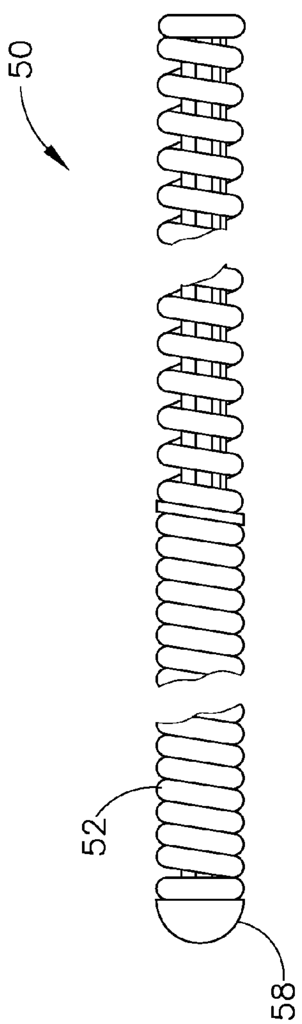

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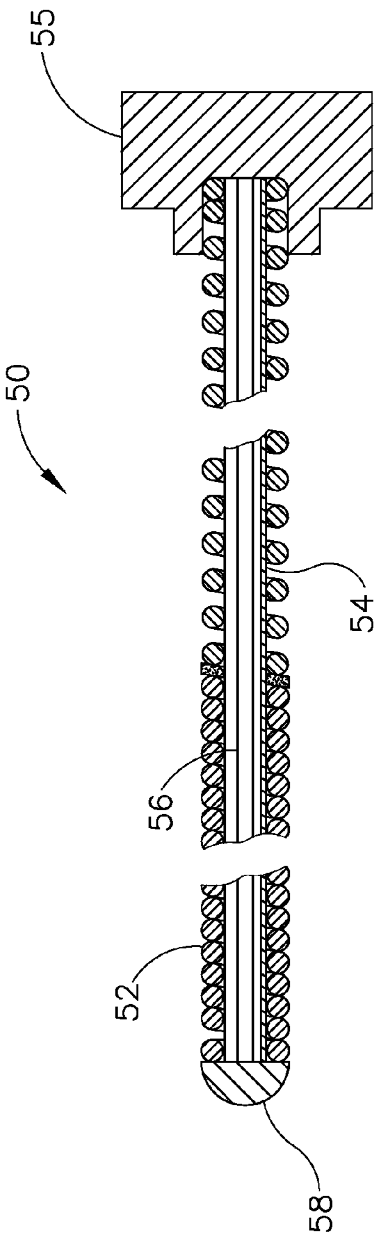

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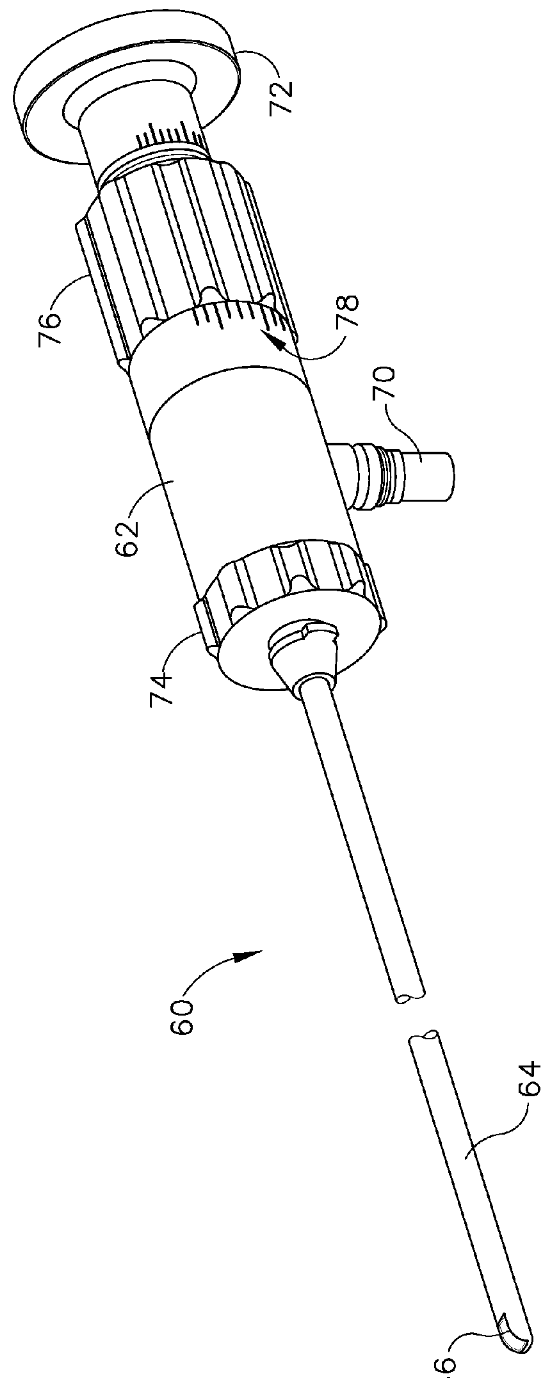

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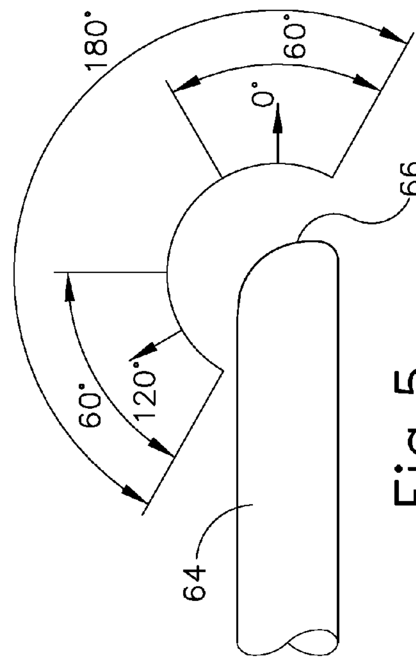

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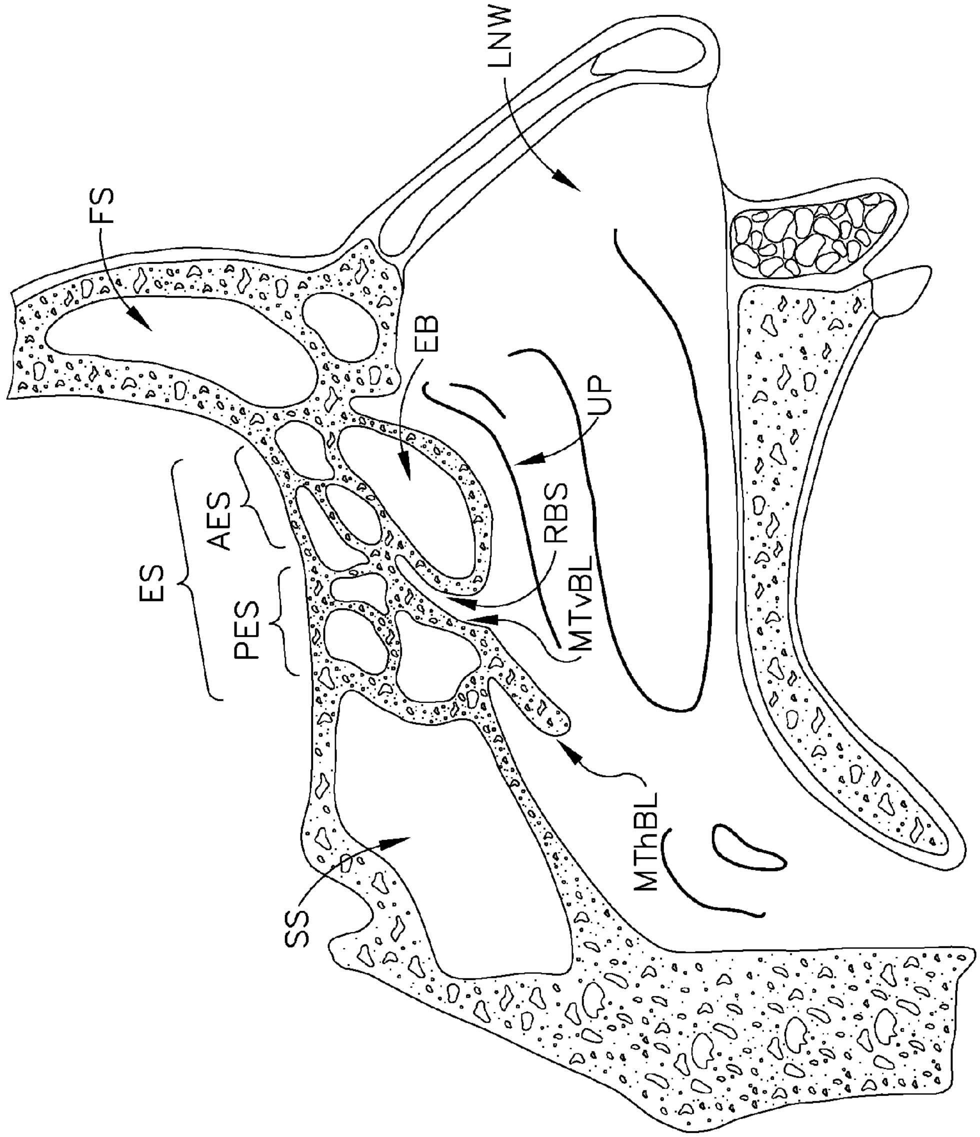

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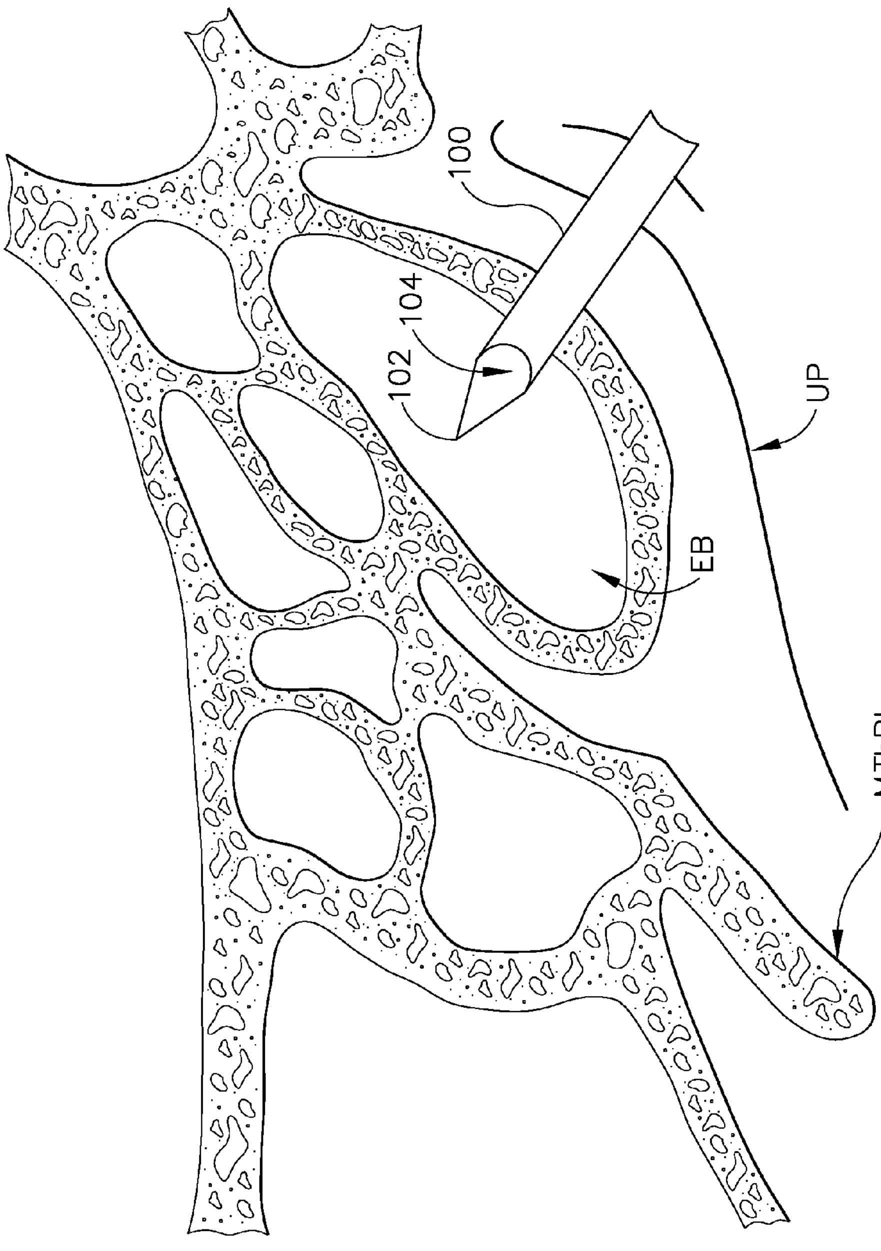

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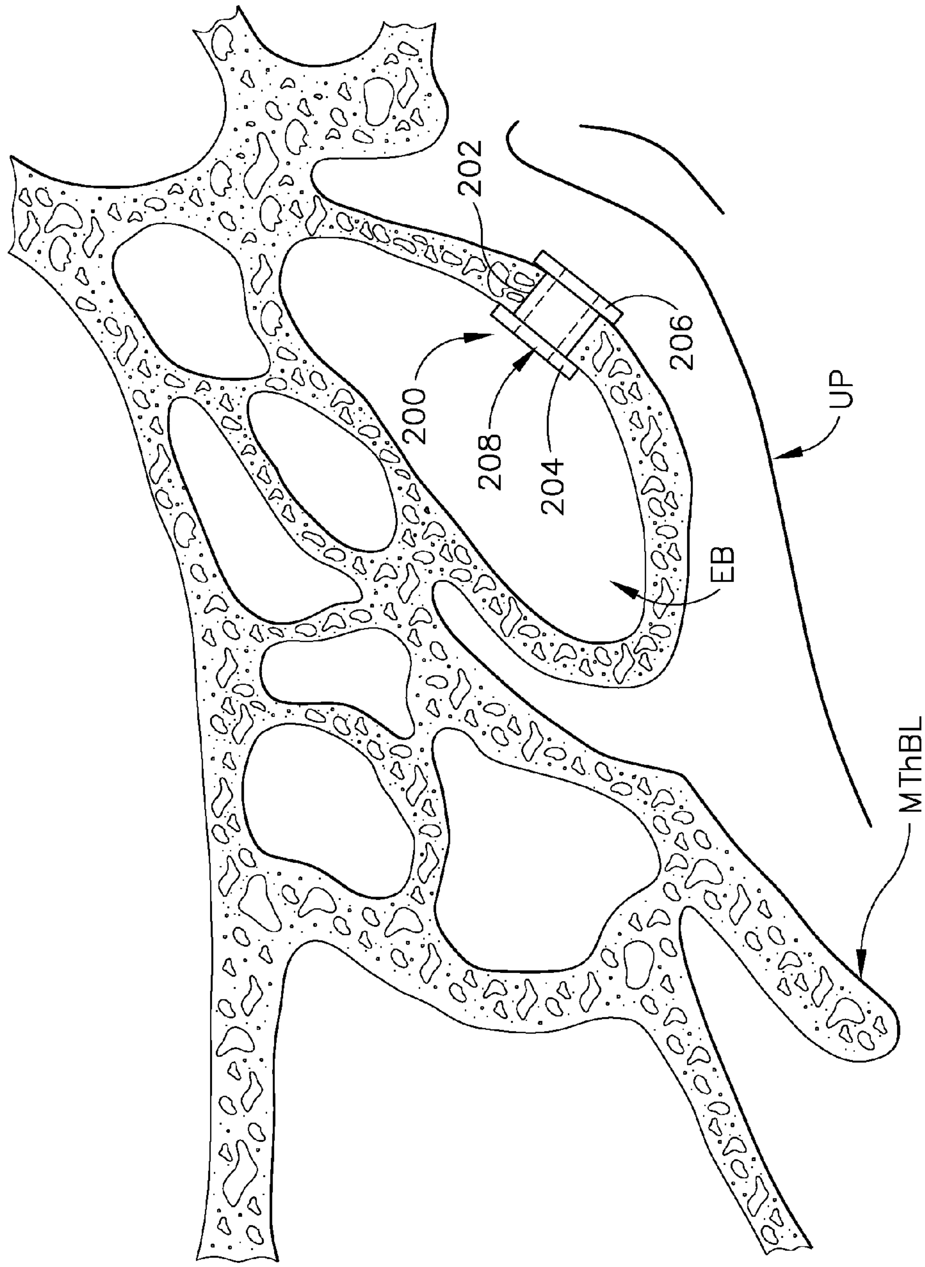

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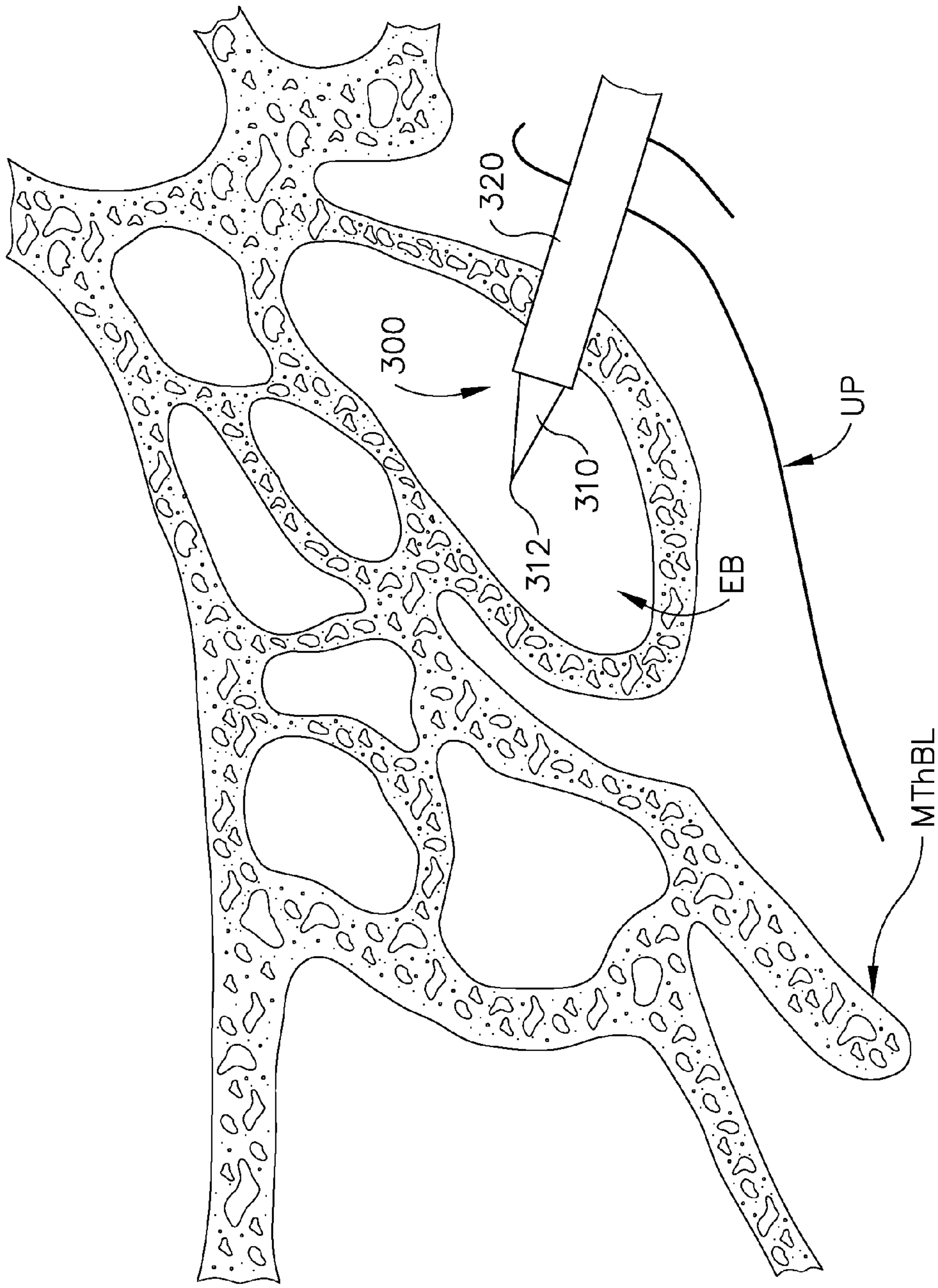

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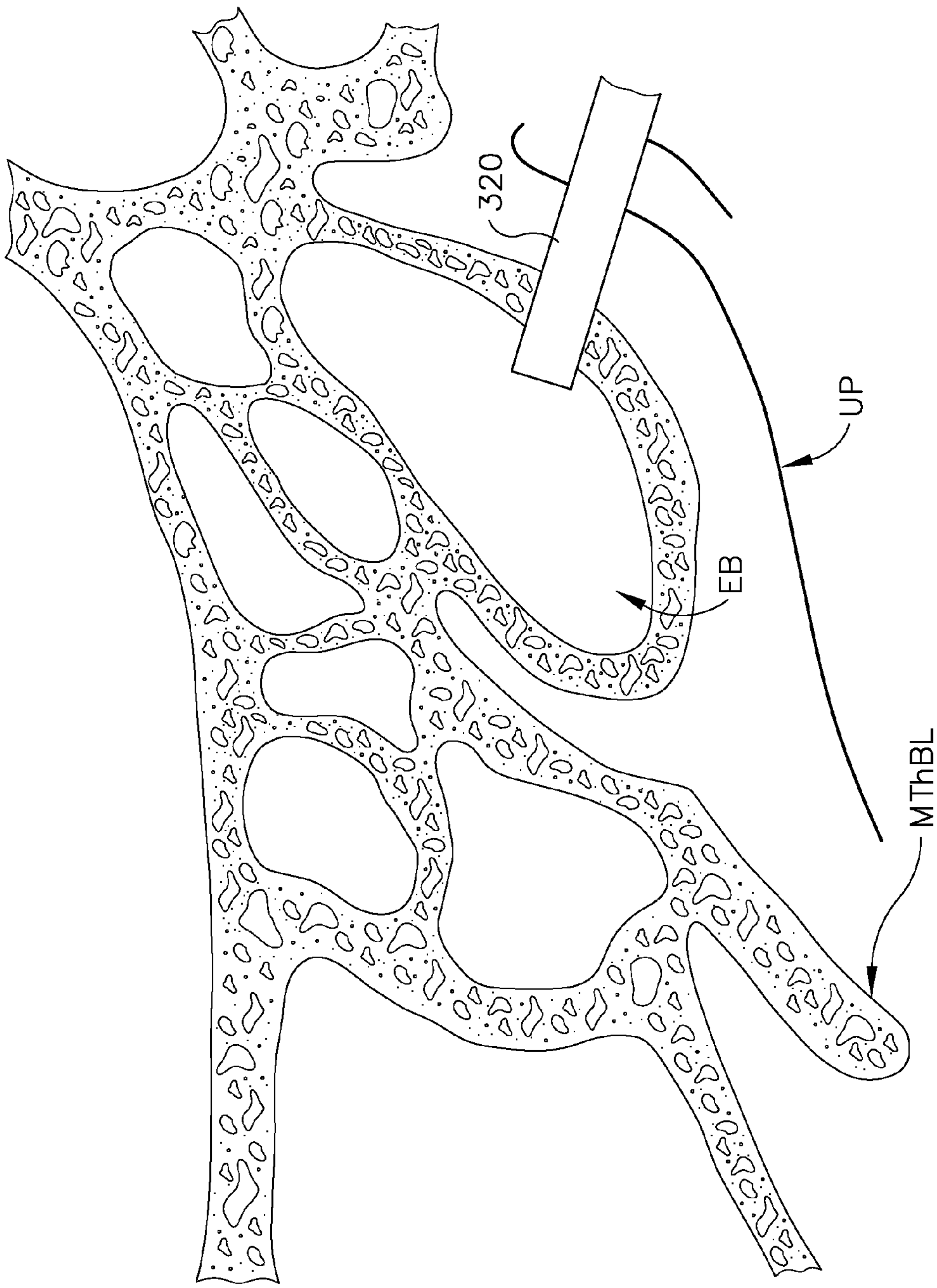

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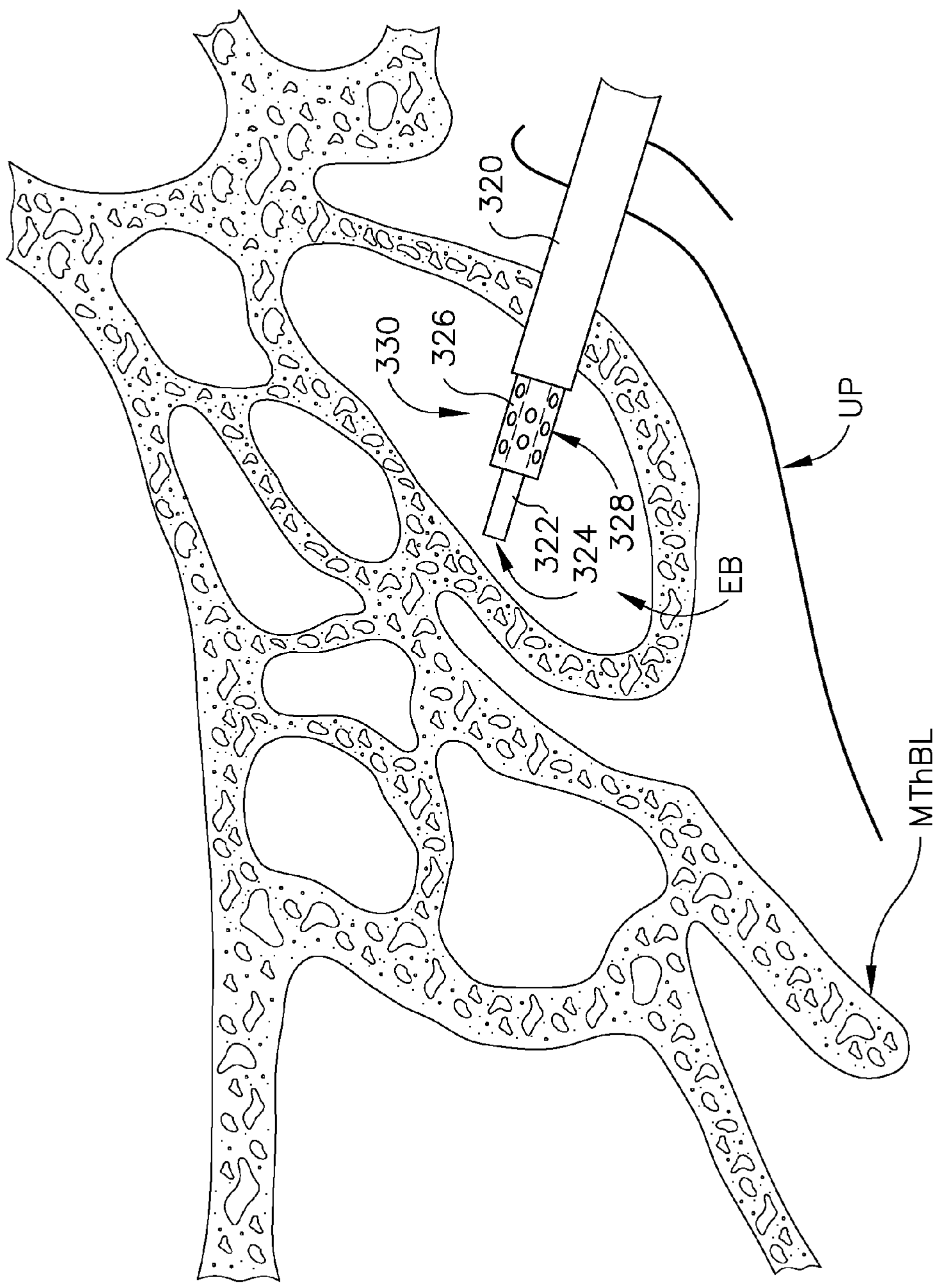

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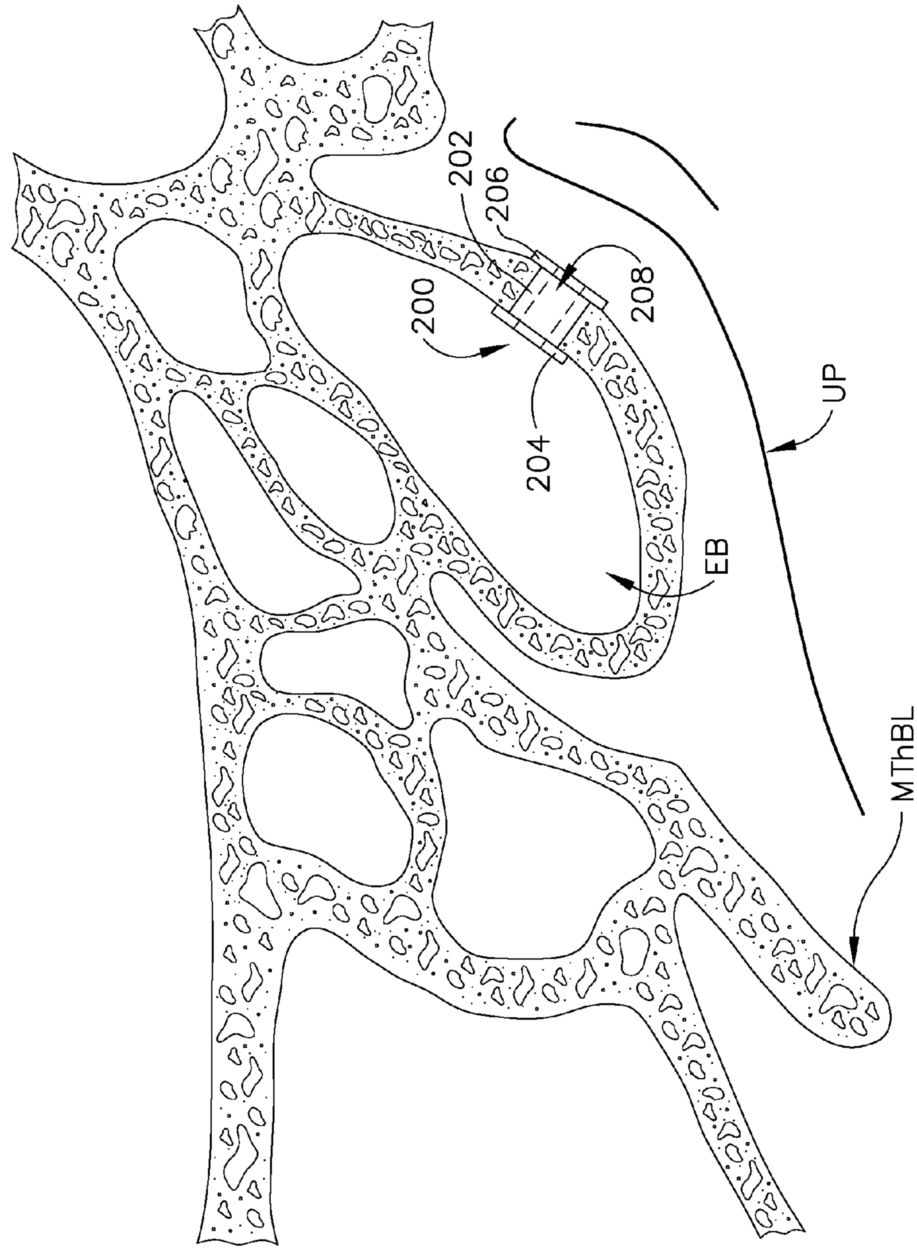

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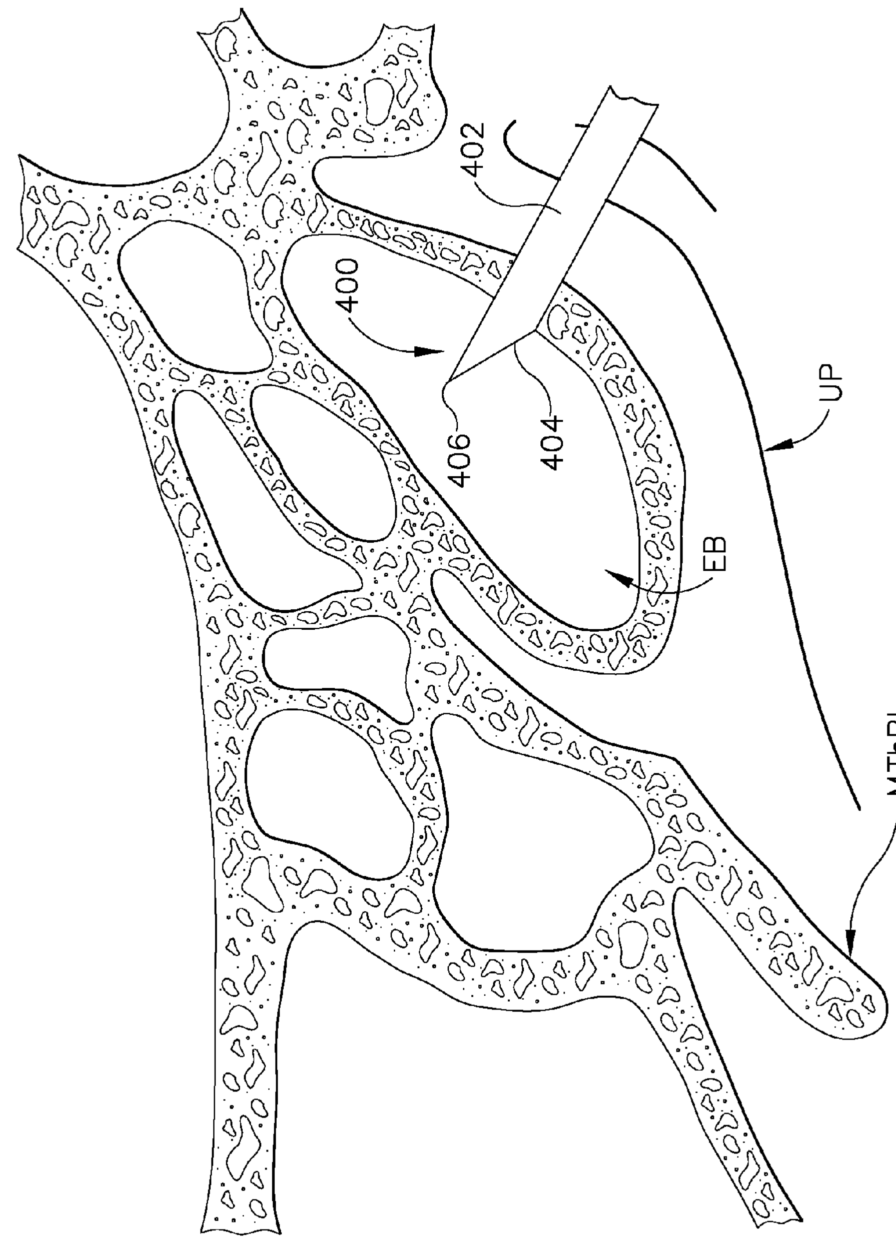

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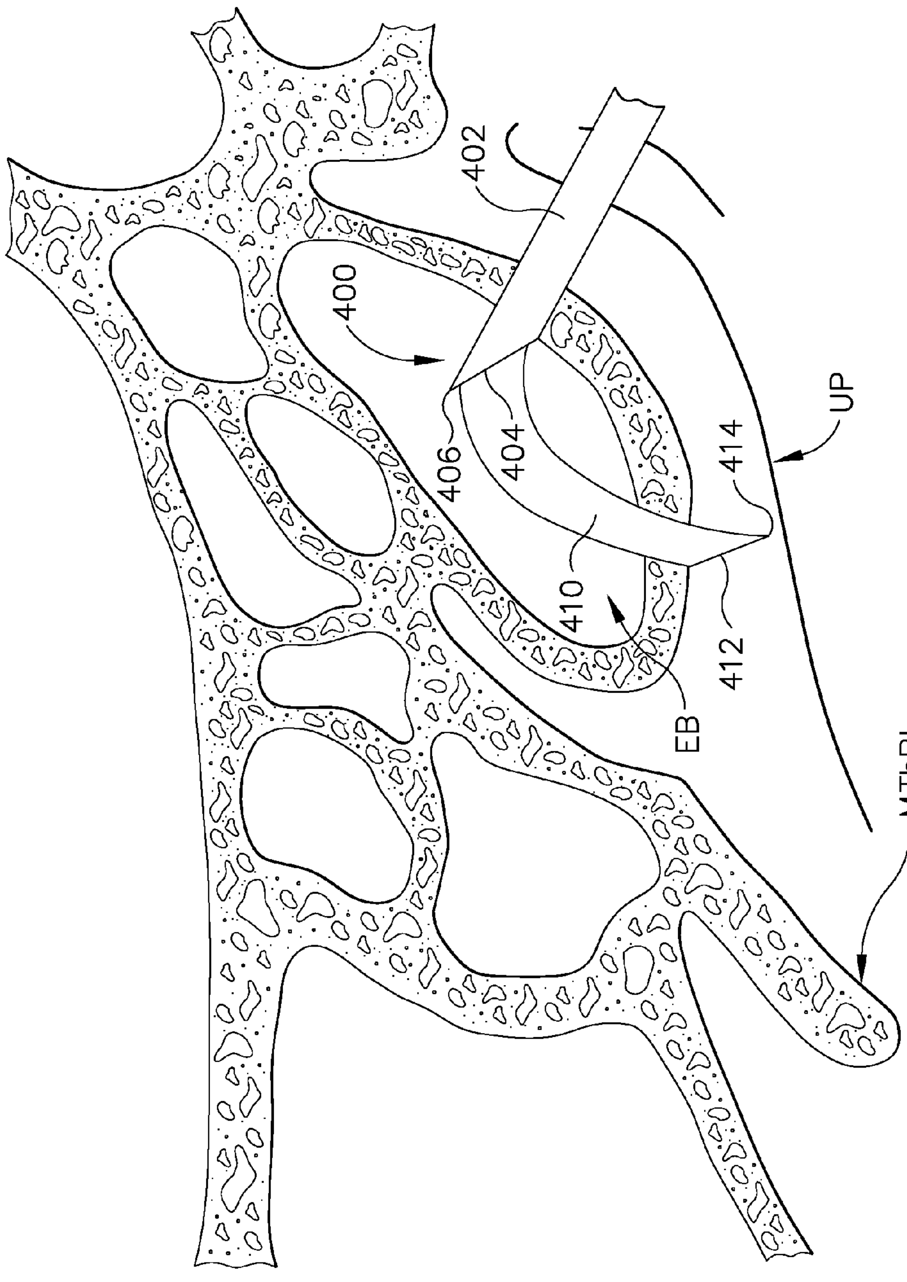

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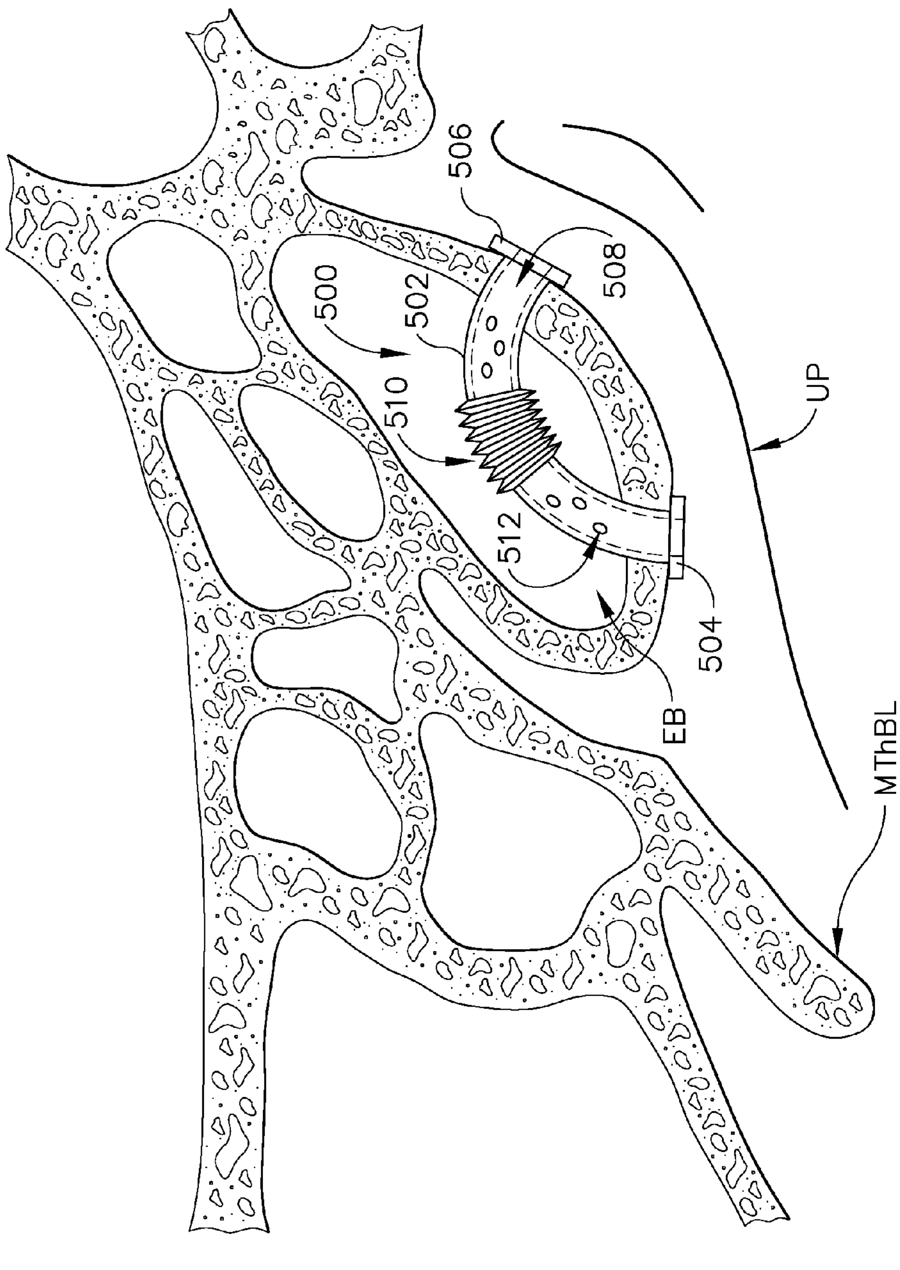

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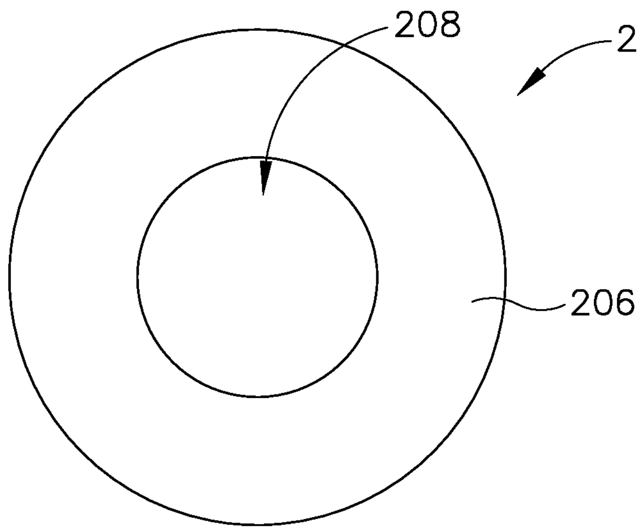

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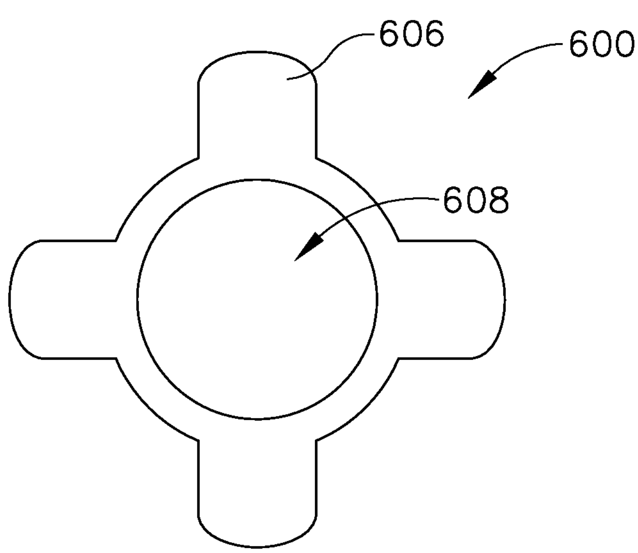

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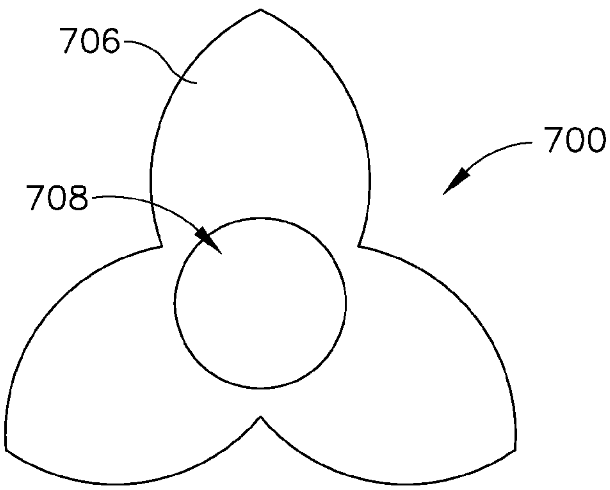

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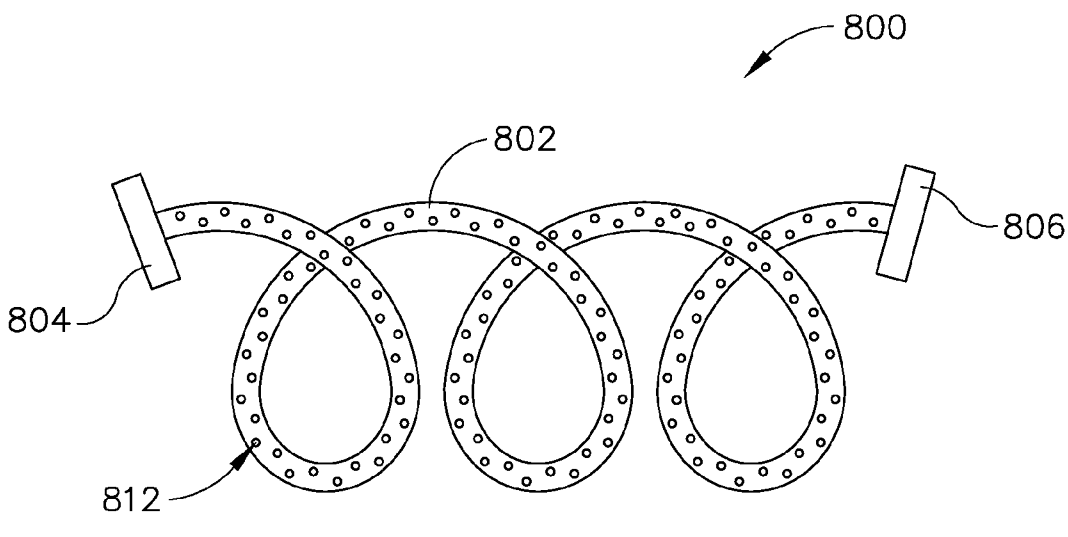

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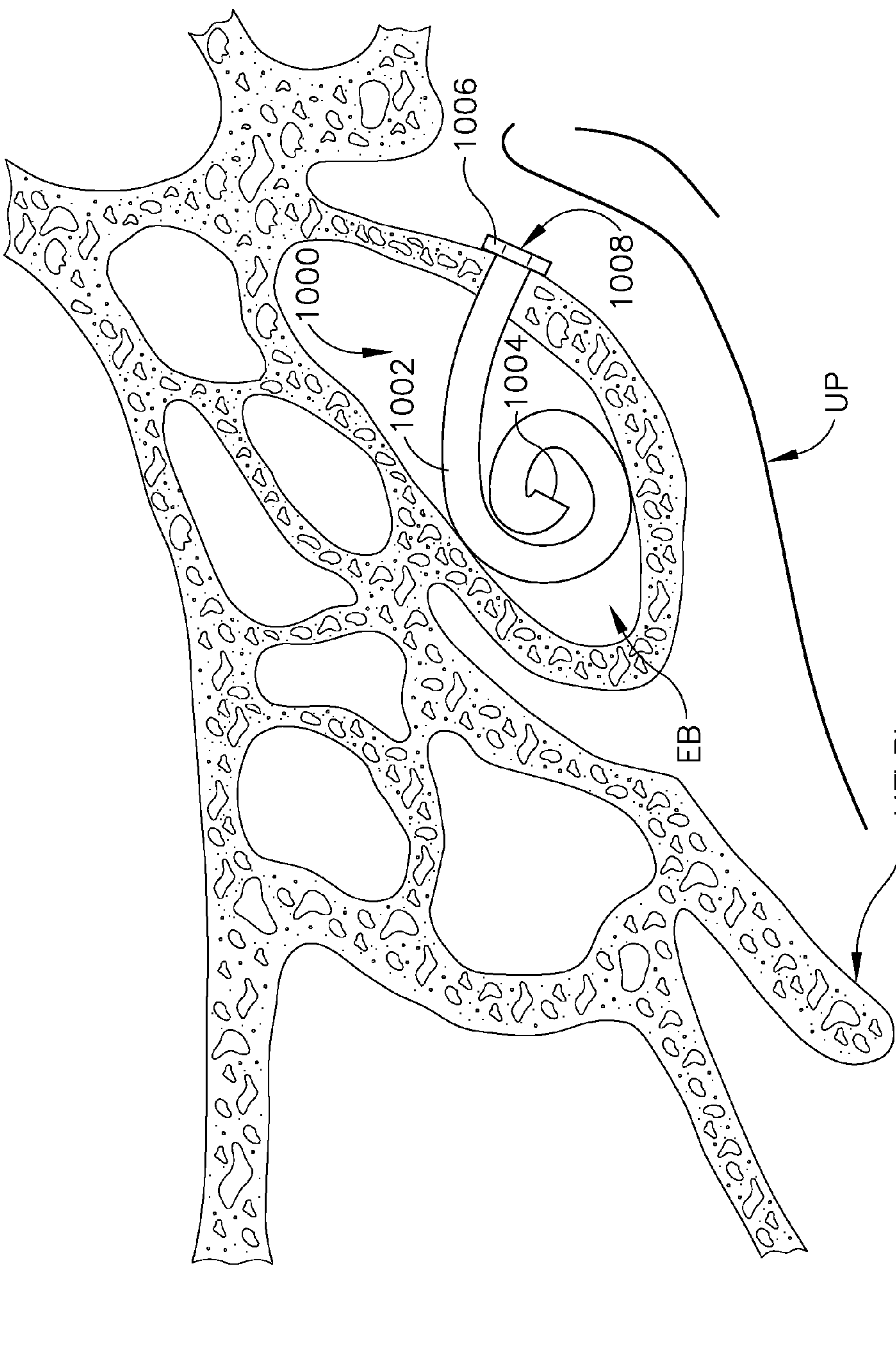

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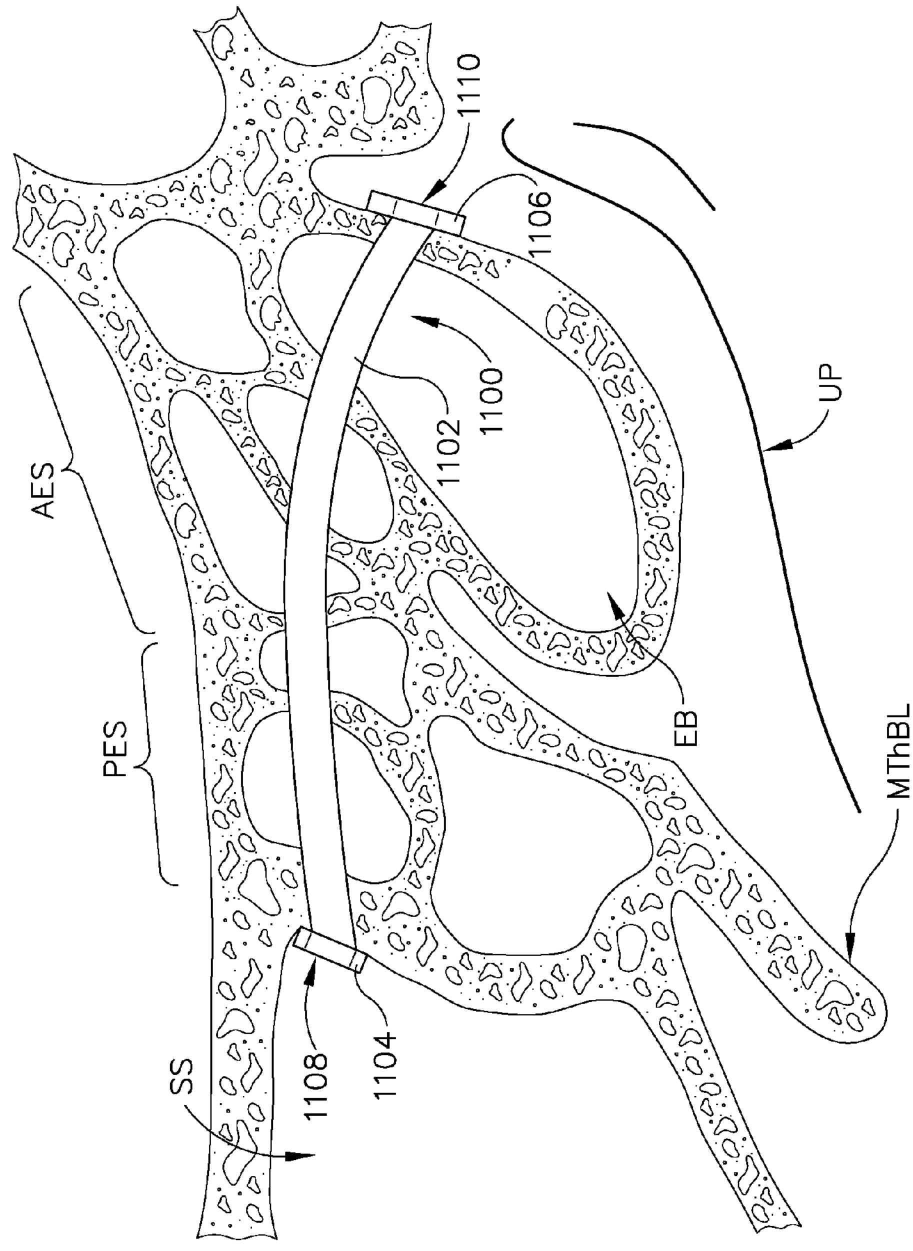

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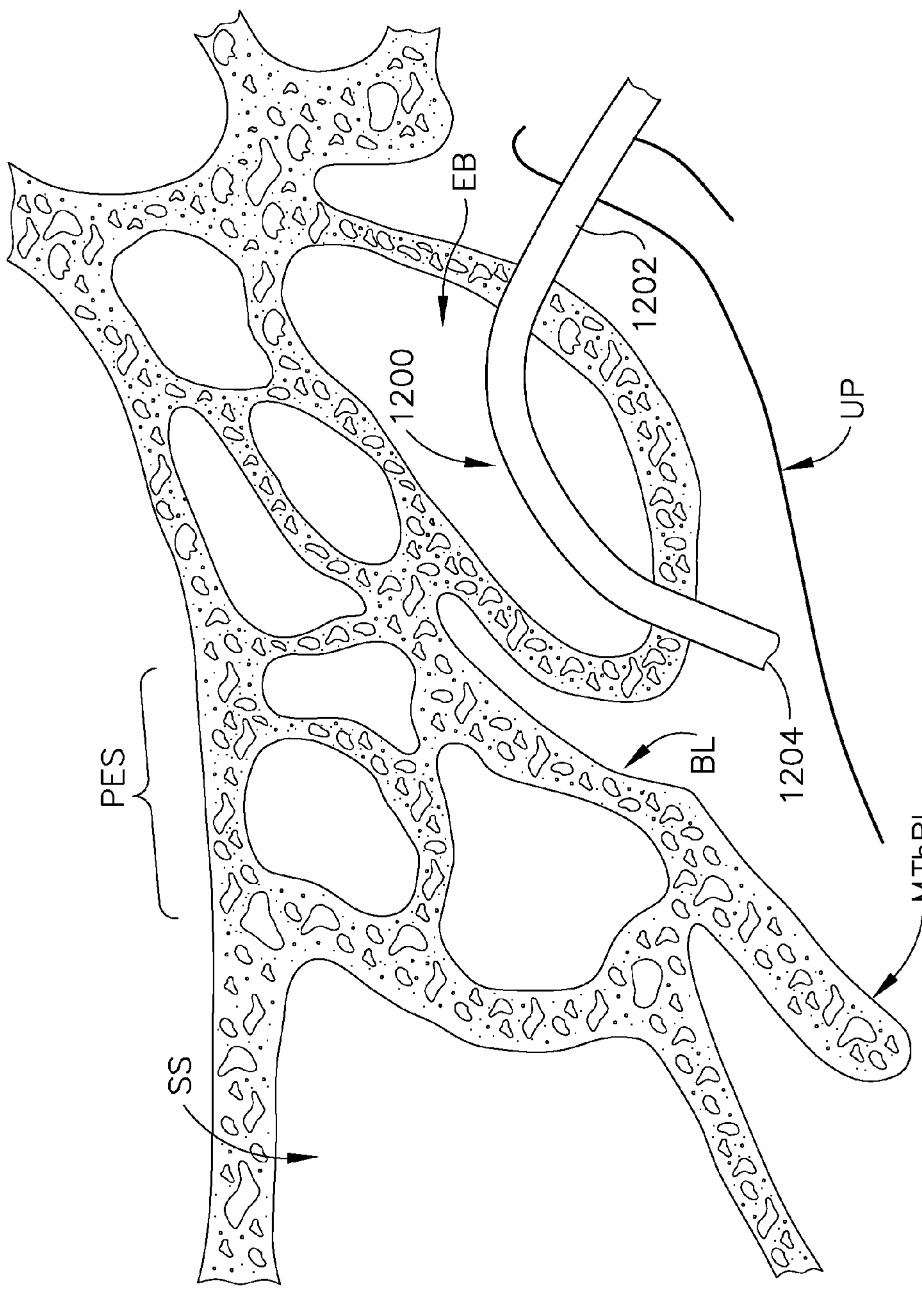

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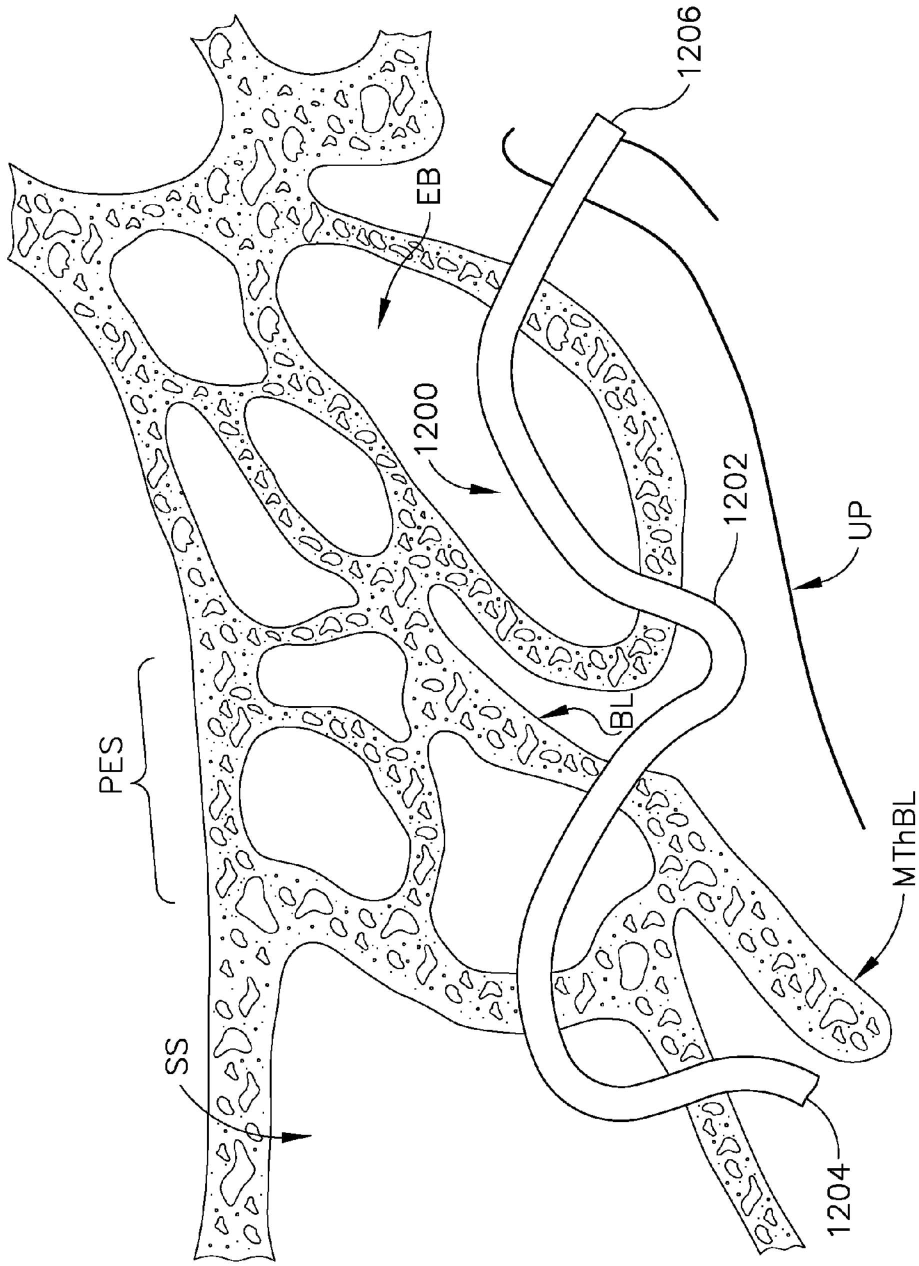

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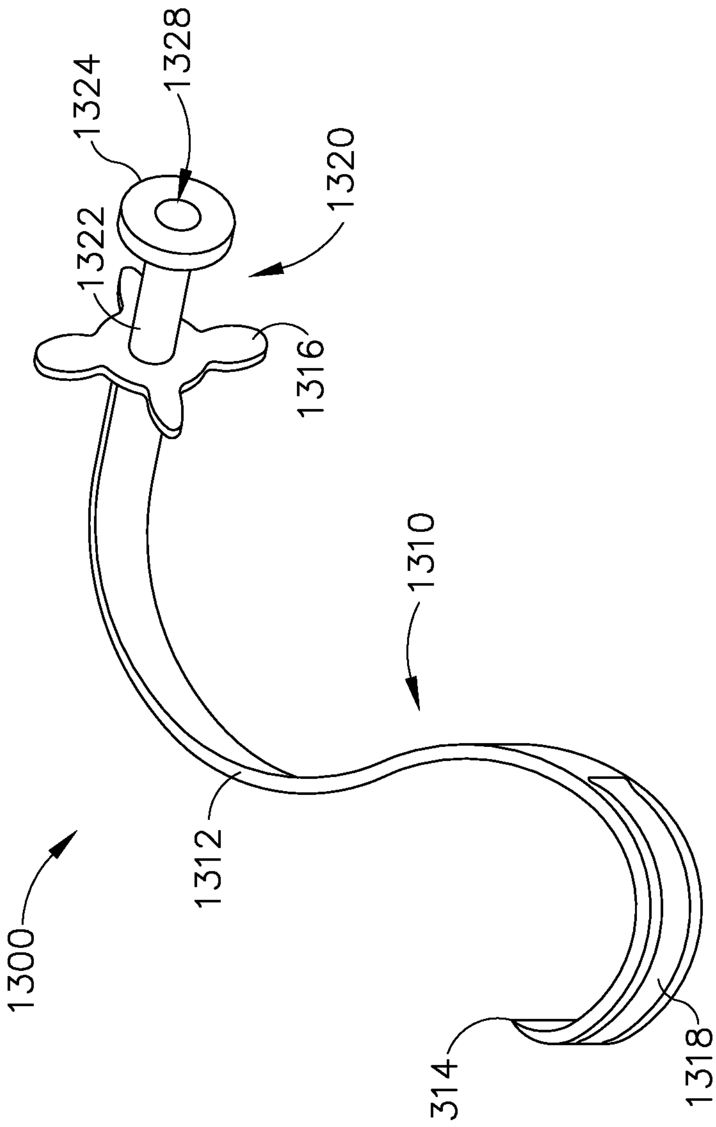

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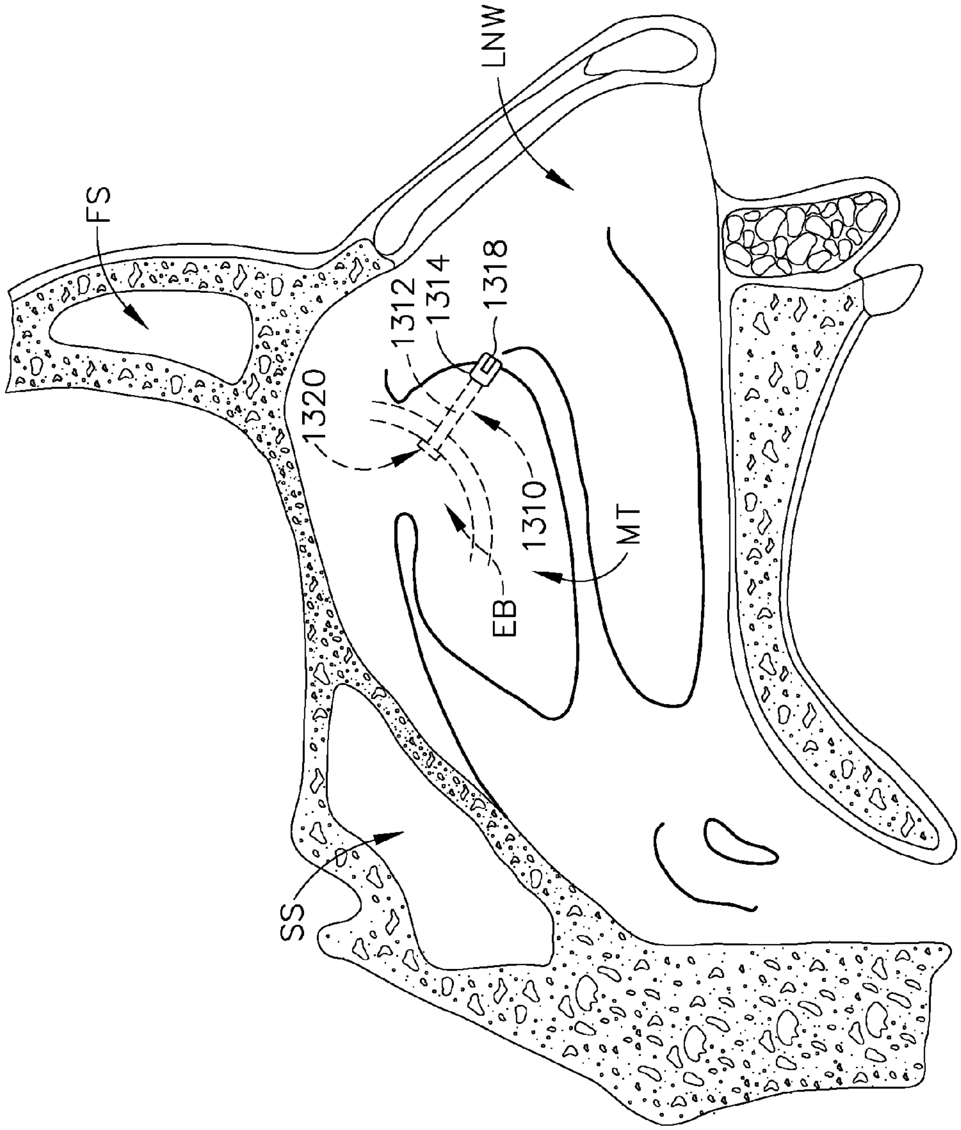

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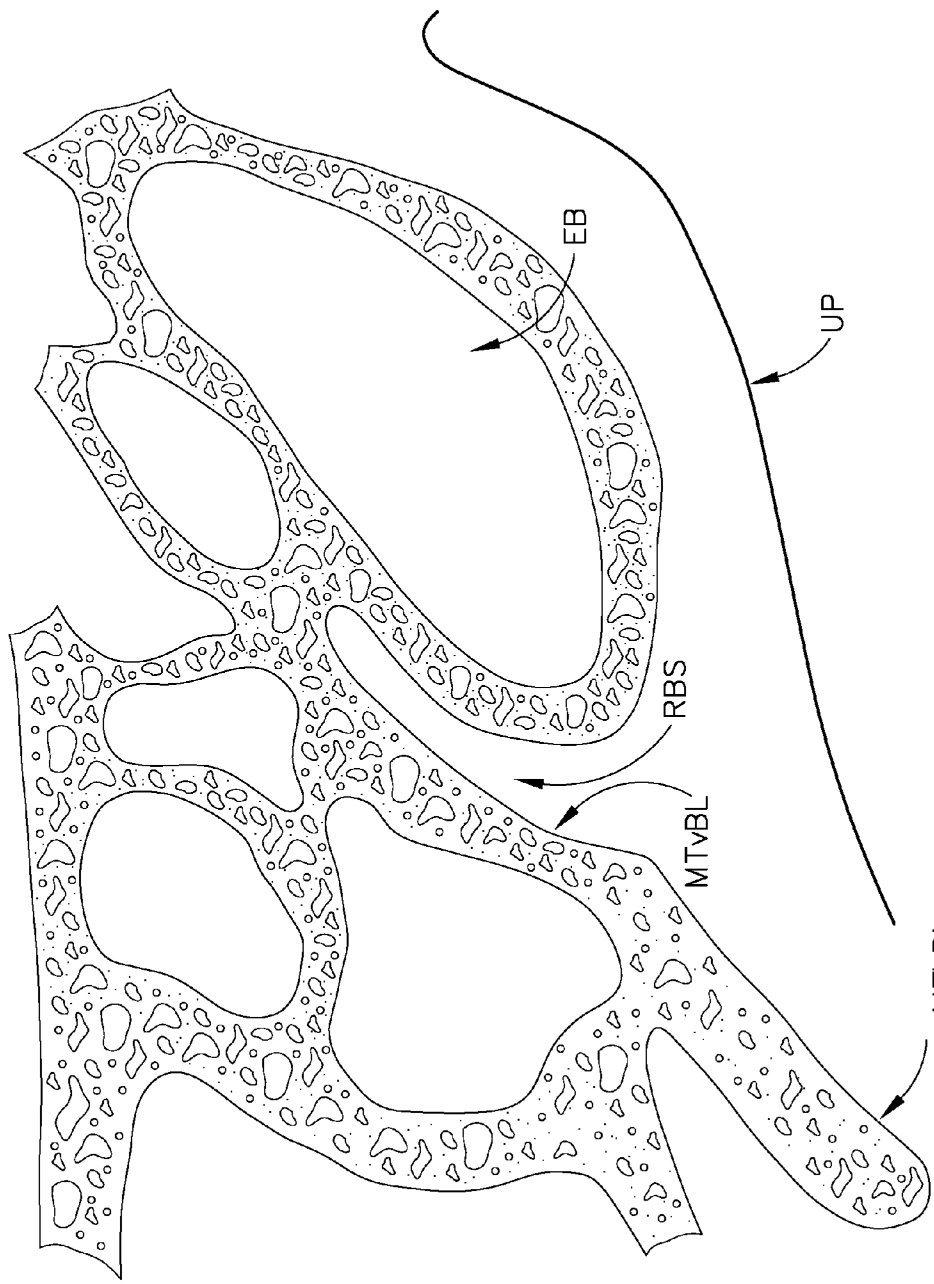

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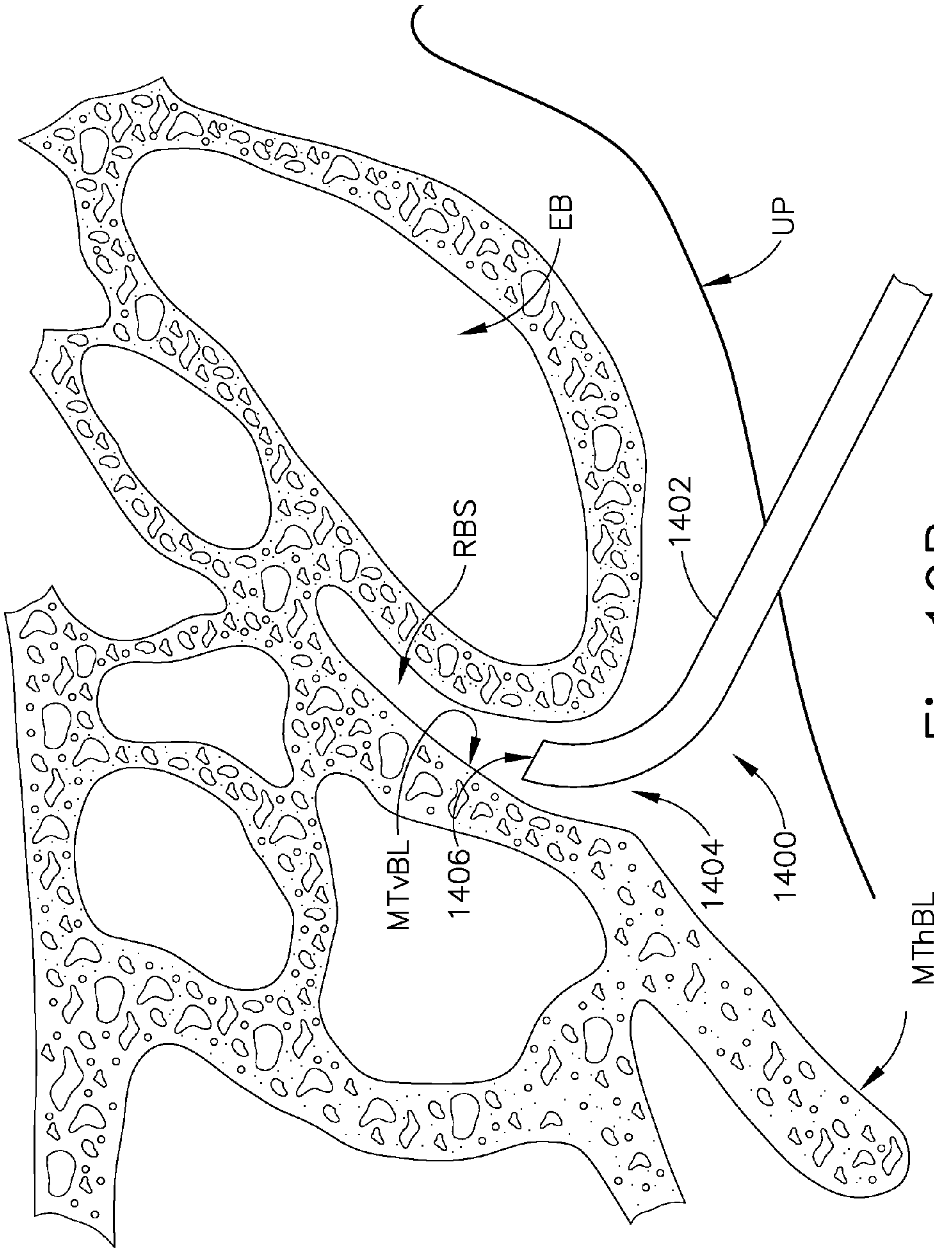

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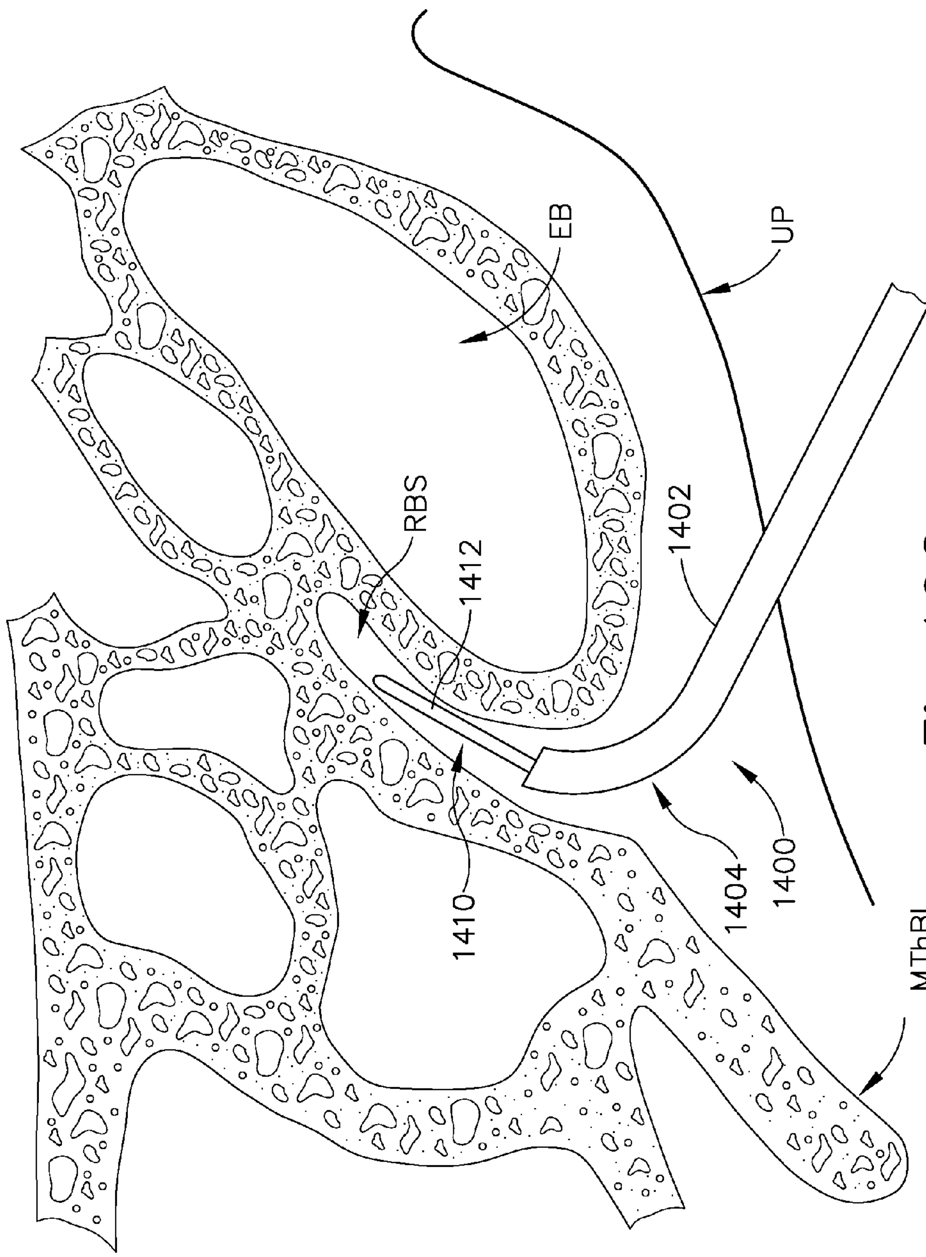

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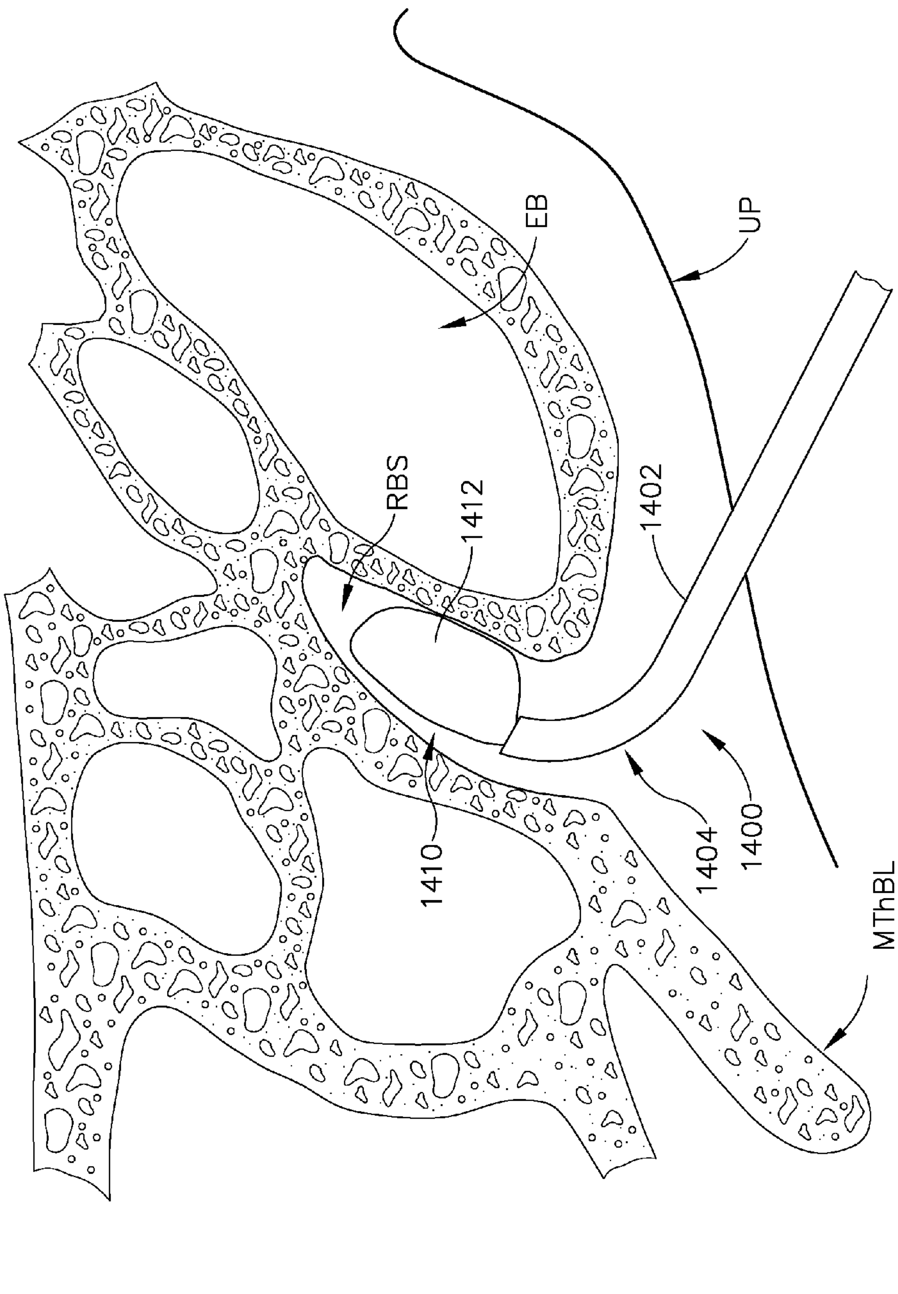

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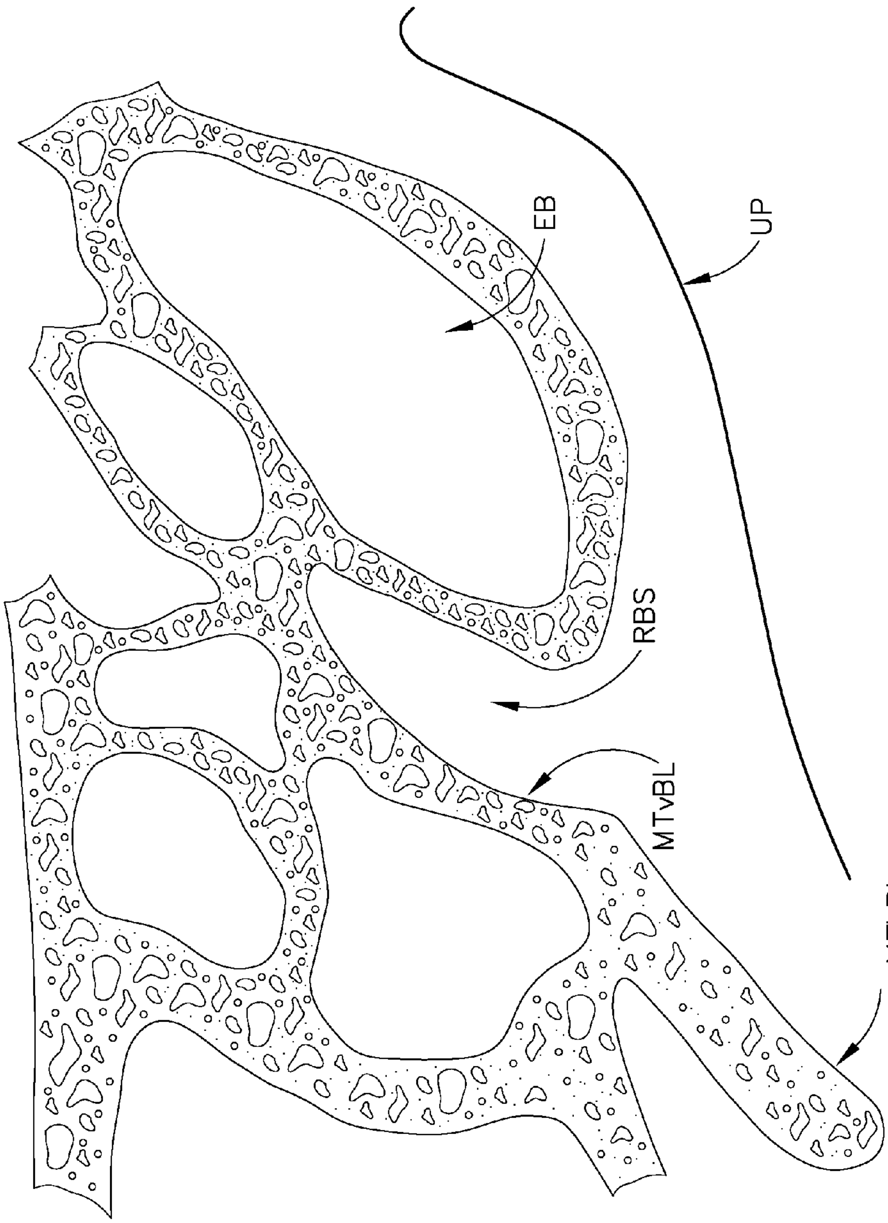

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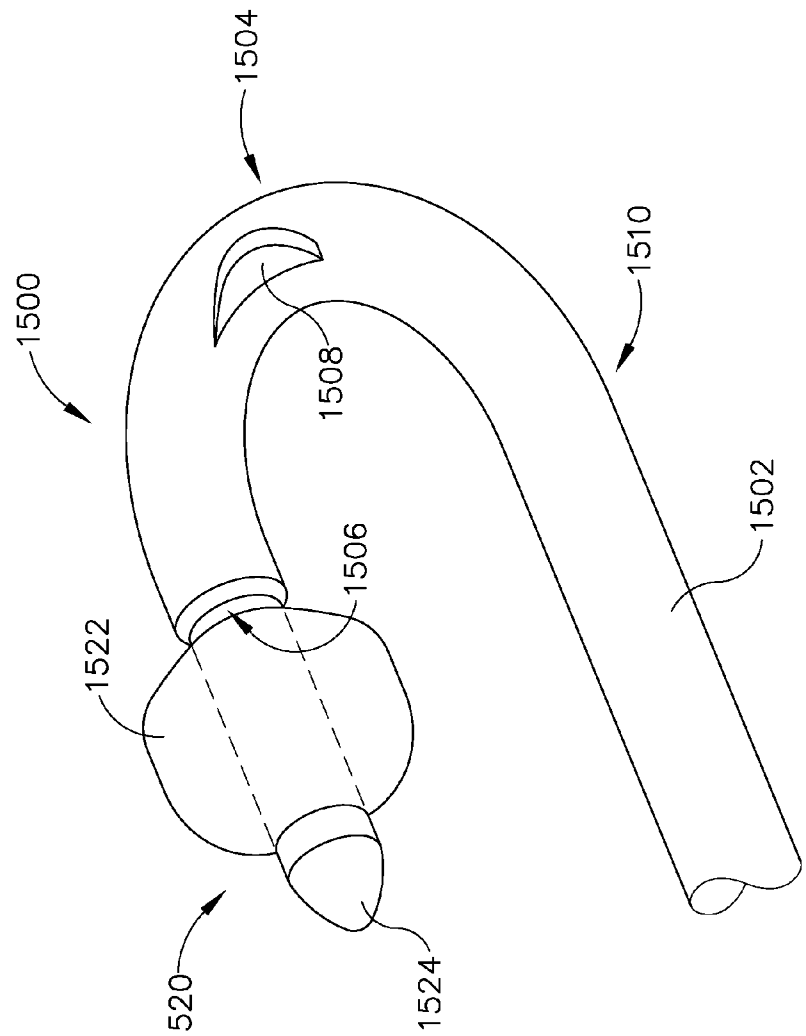

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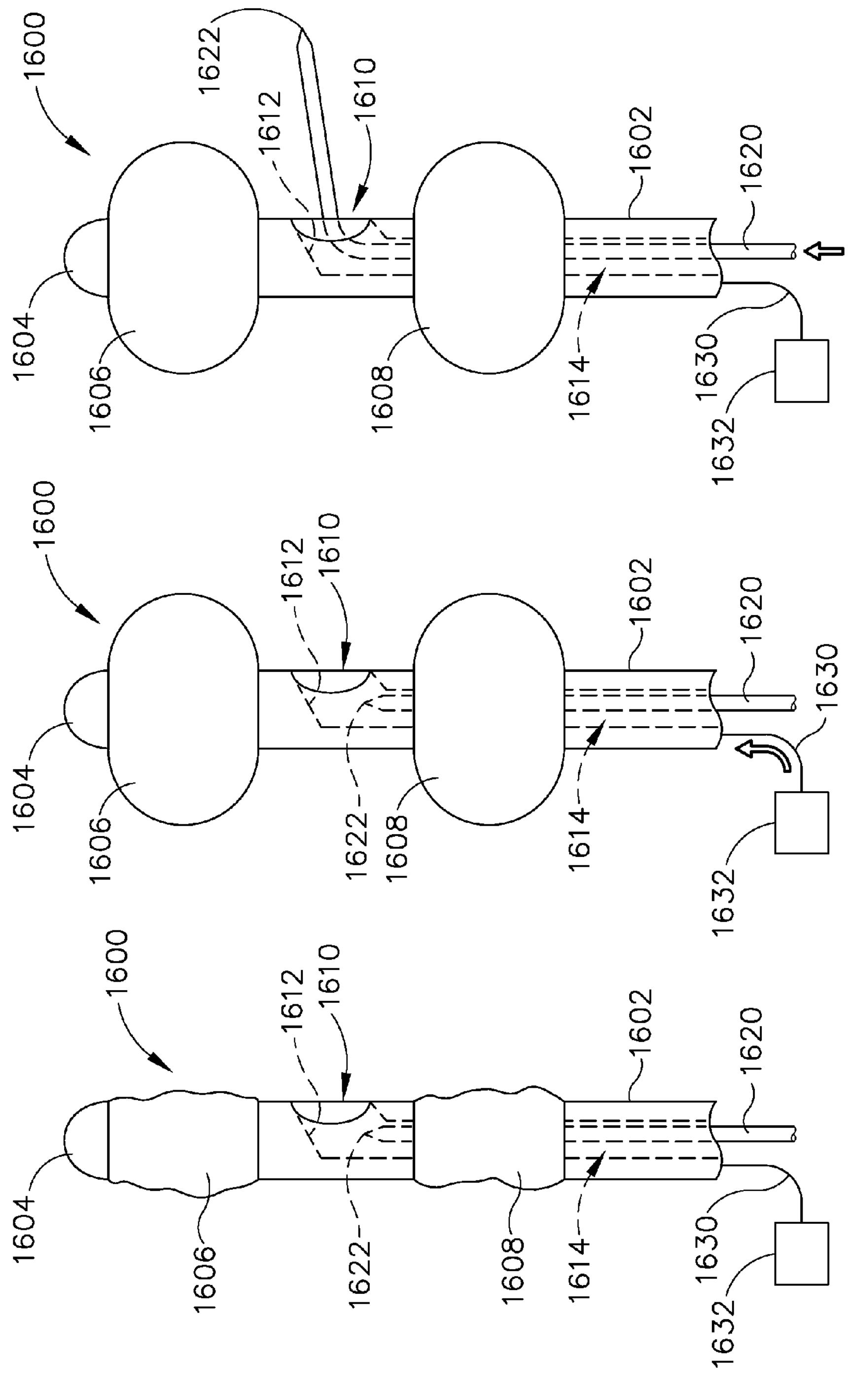
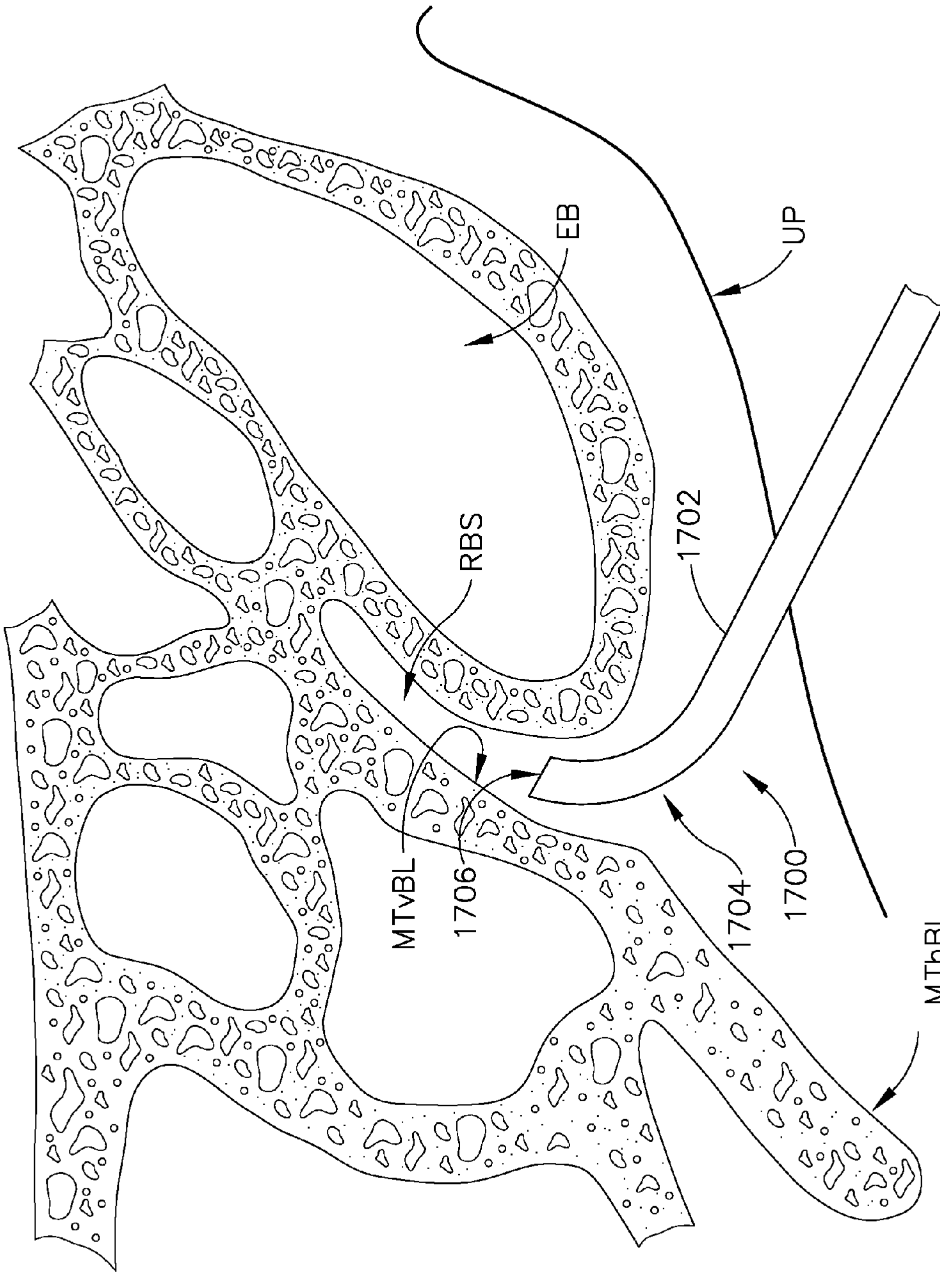


Fig.21A

Fig.21B

Fig.21C



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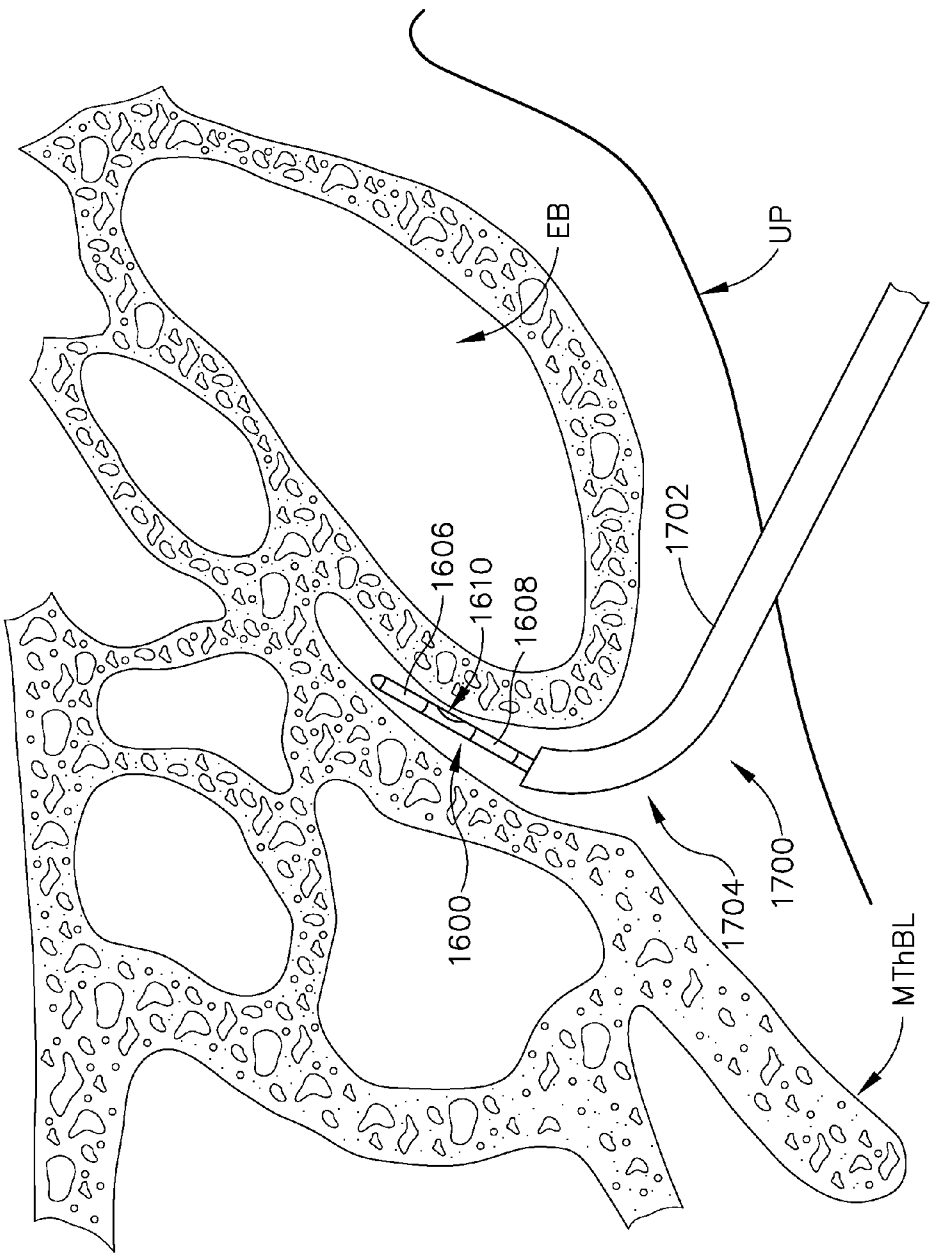

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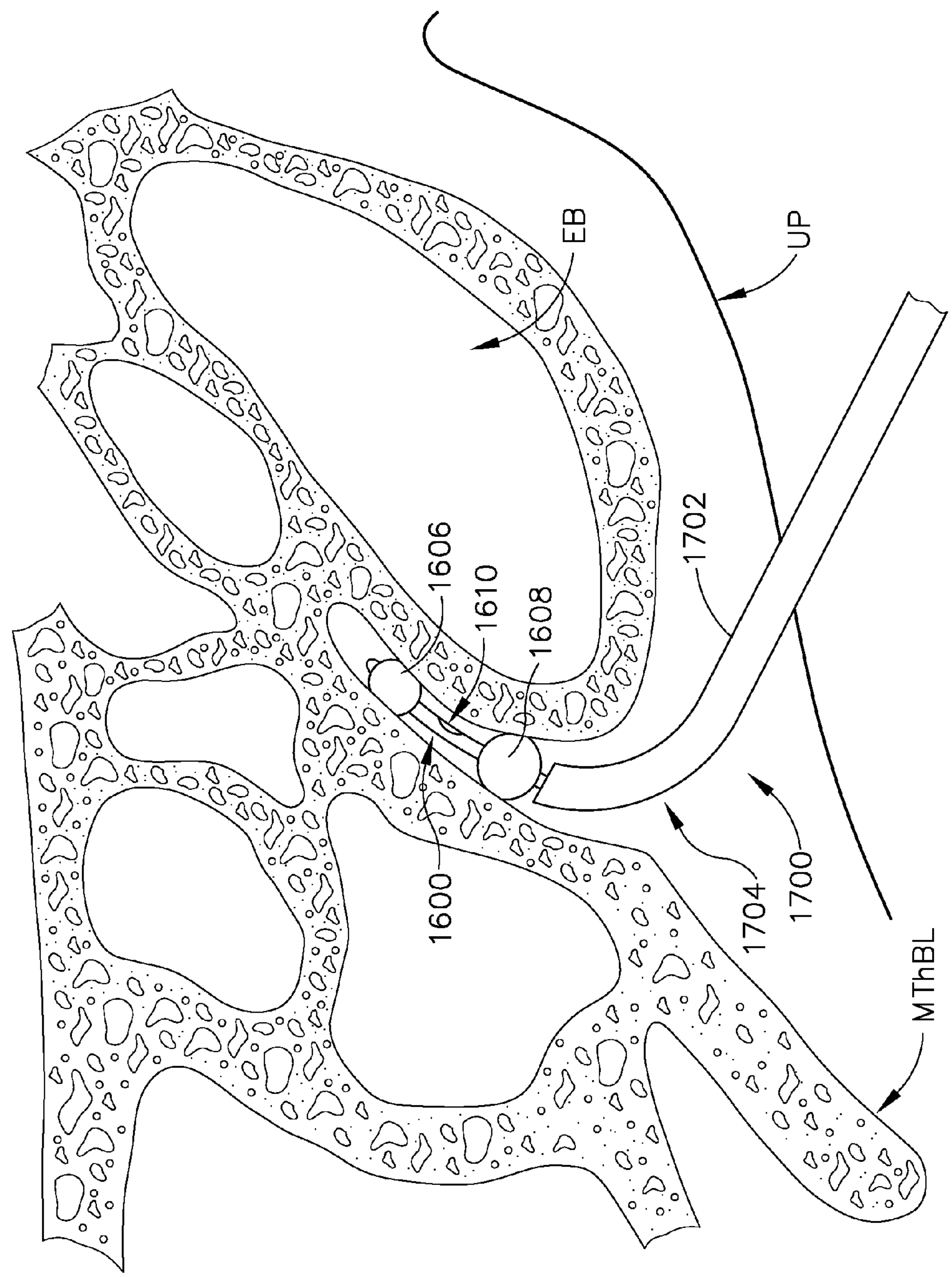

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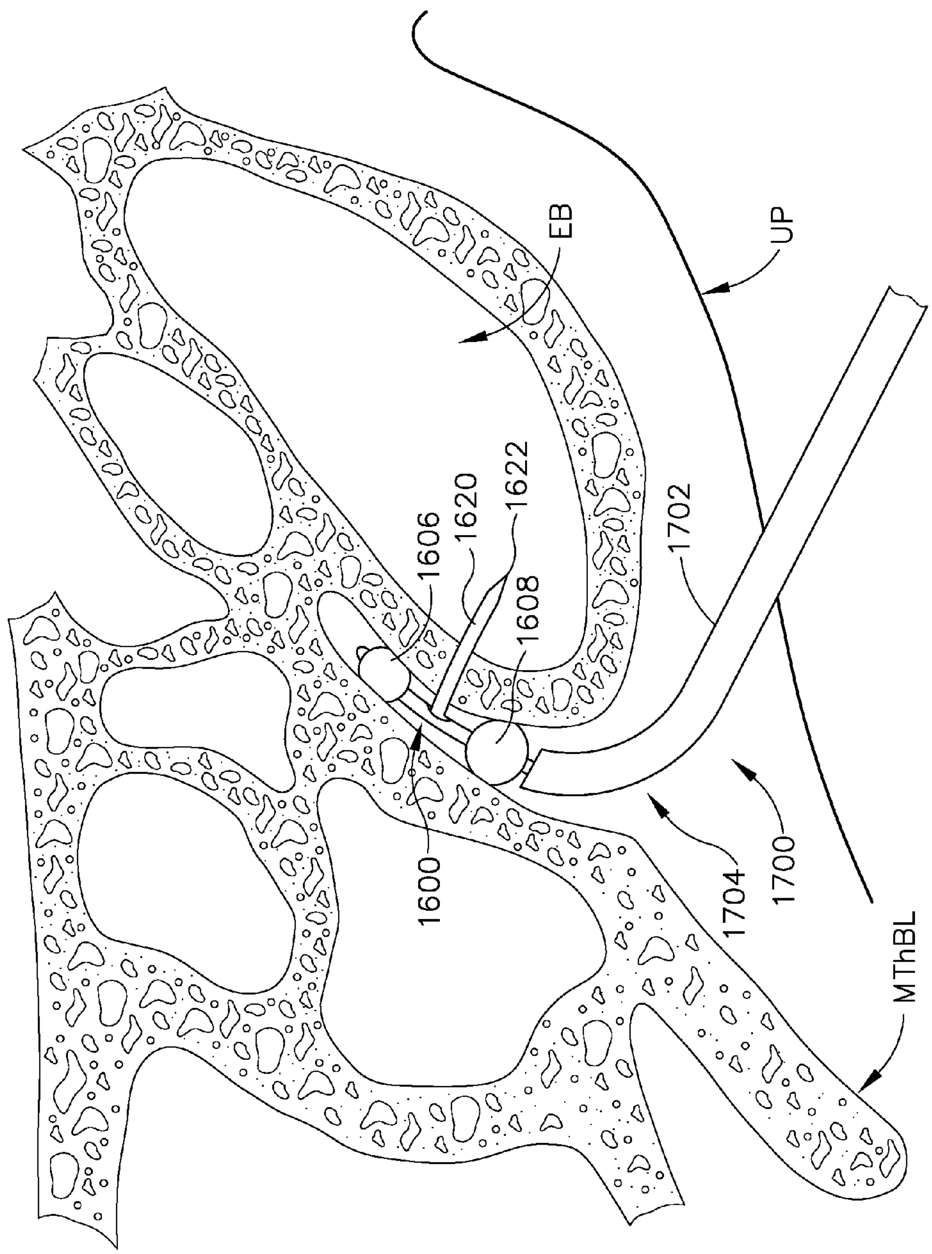

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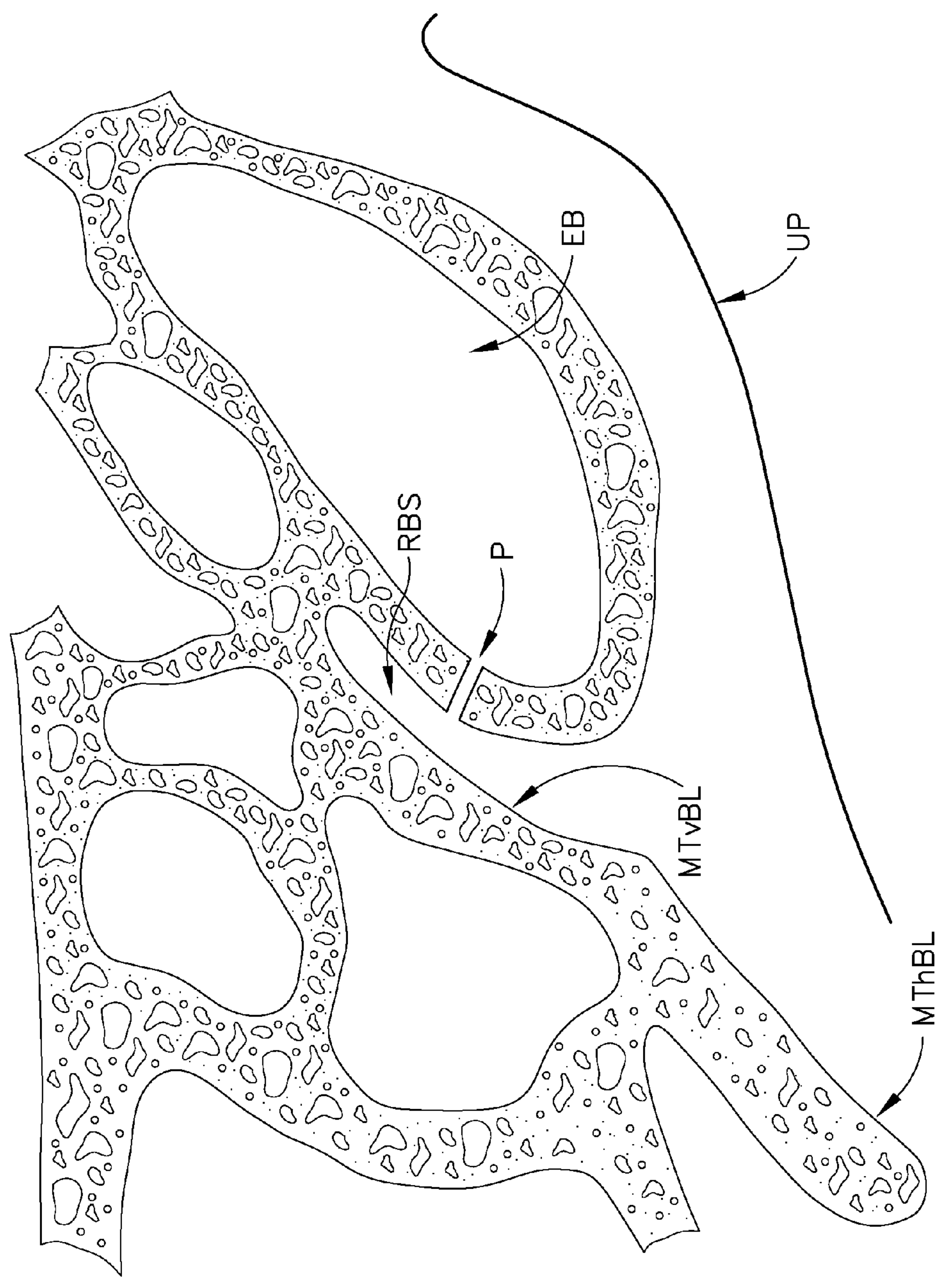

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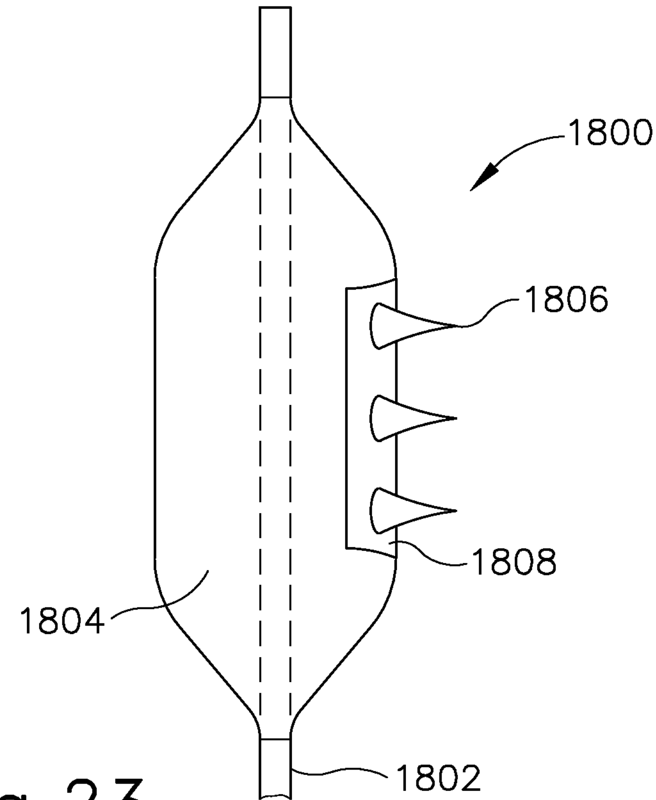
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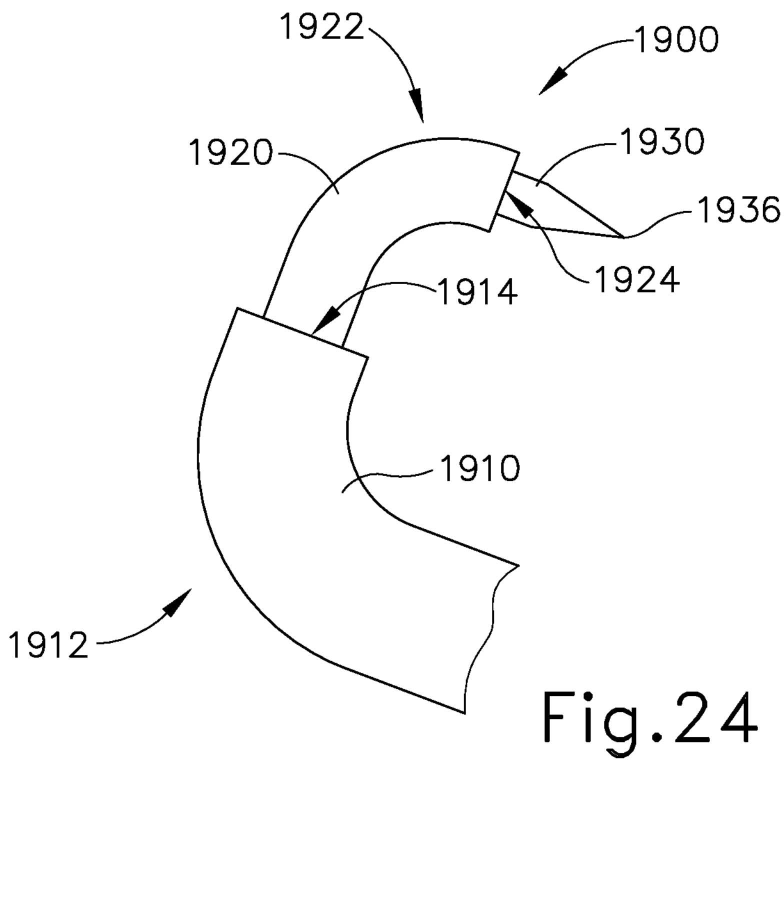
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Fig.24

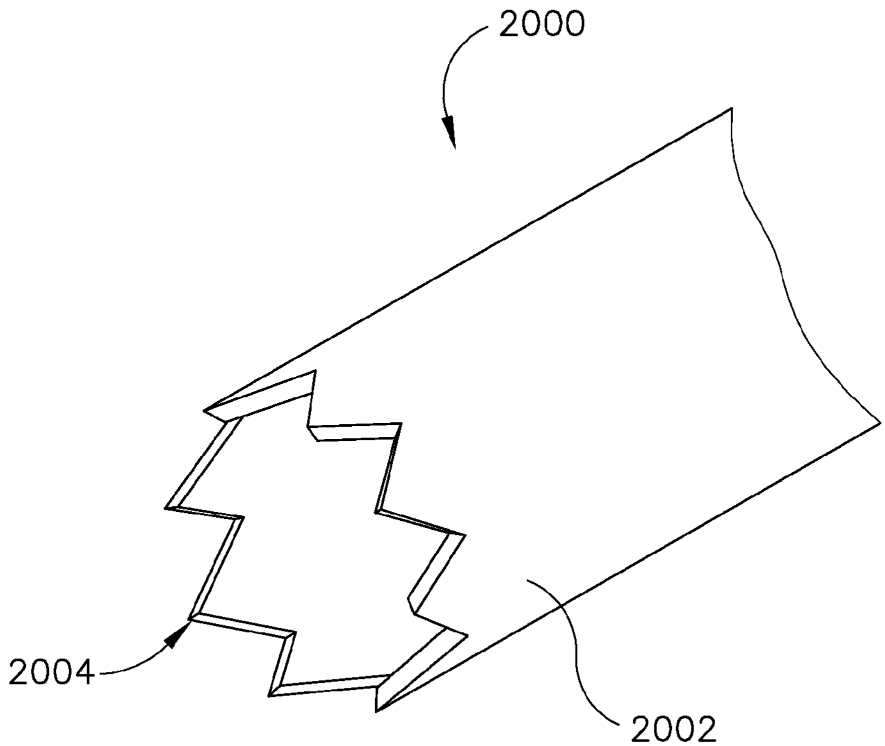

Fig.25

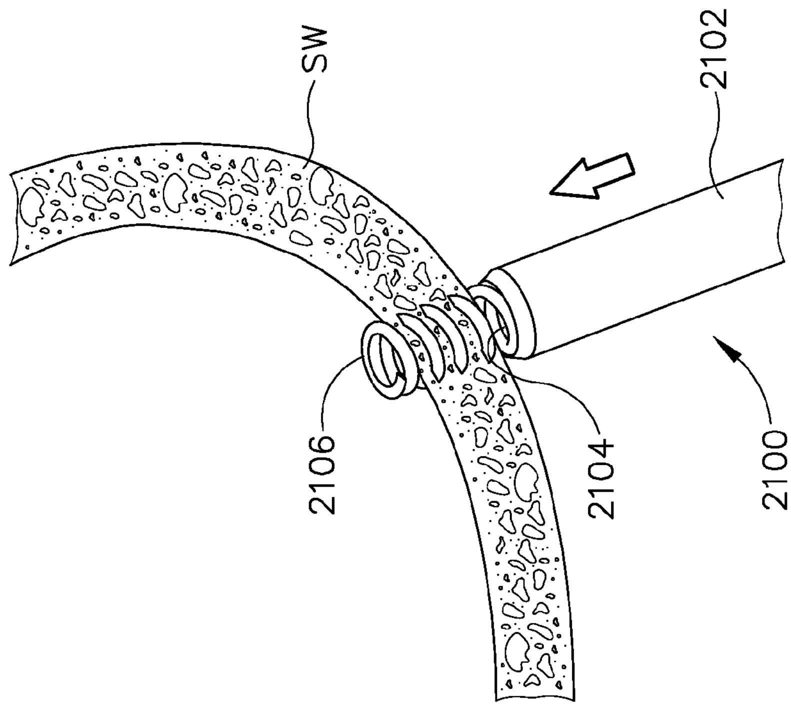

Fig.26B

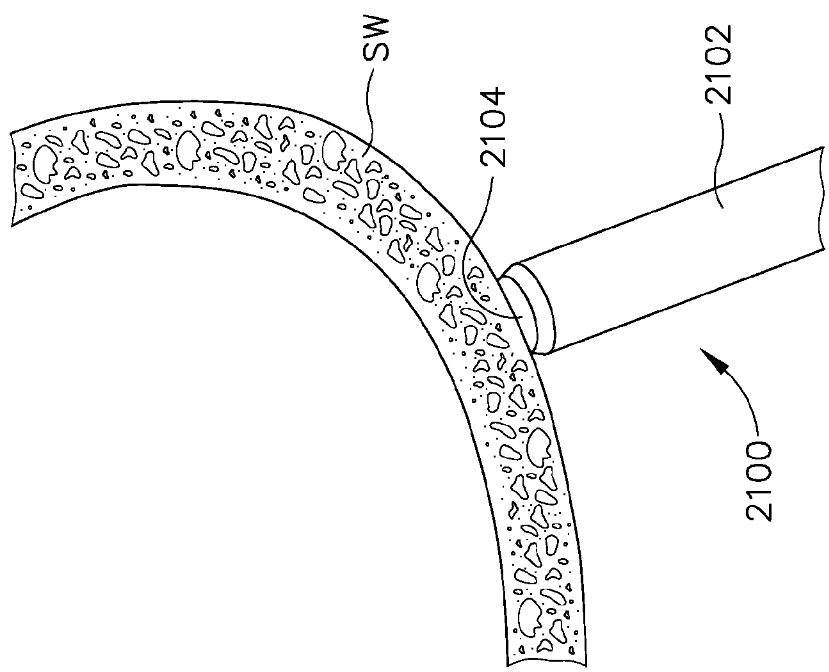

Fig.26A

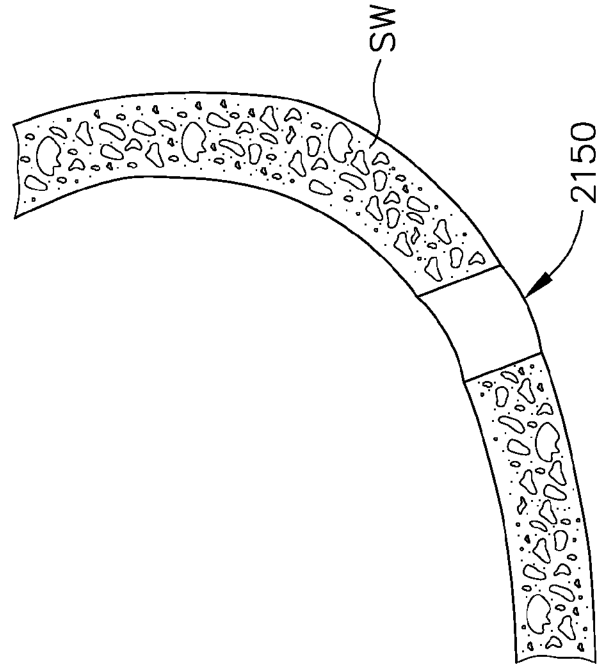

Fig.26D

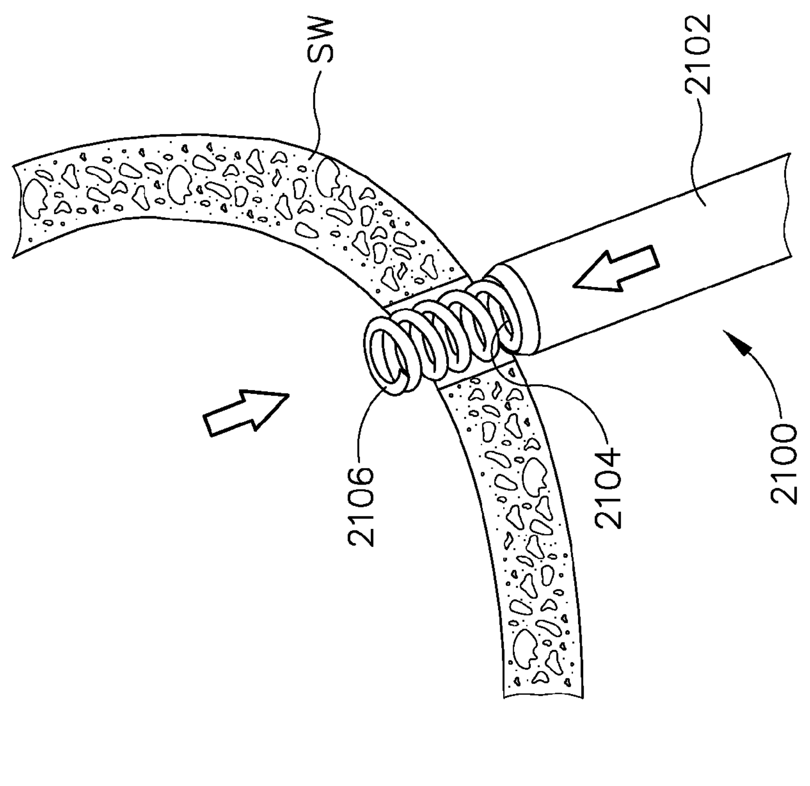

Fig.26C

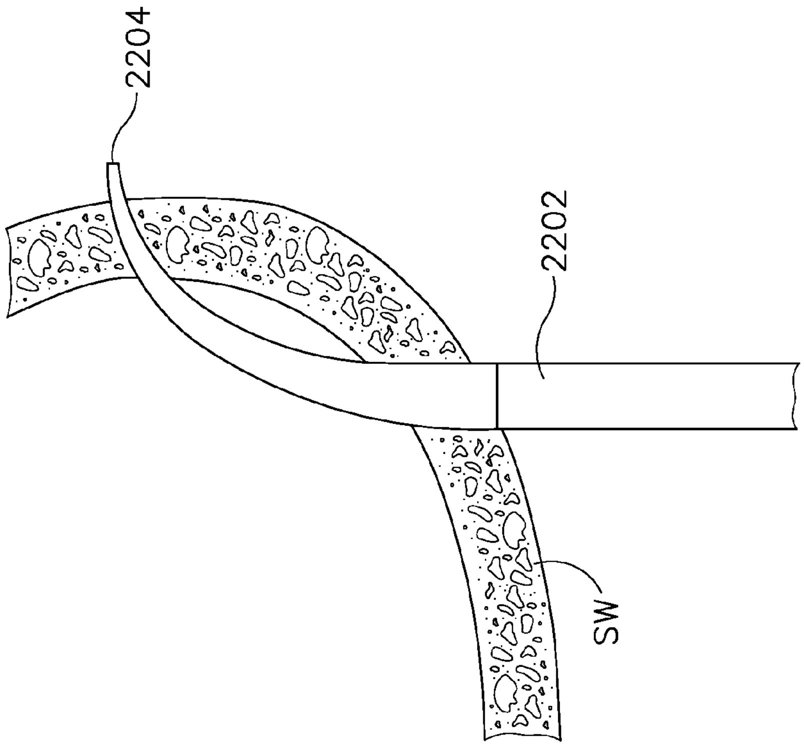

Fig.27B

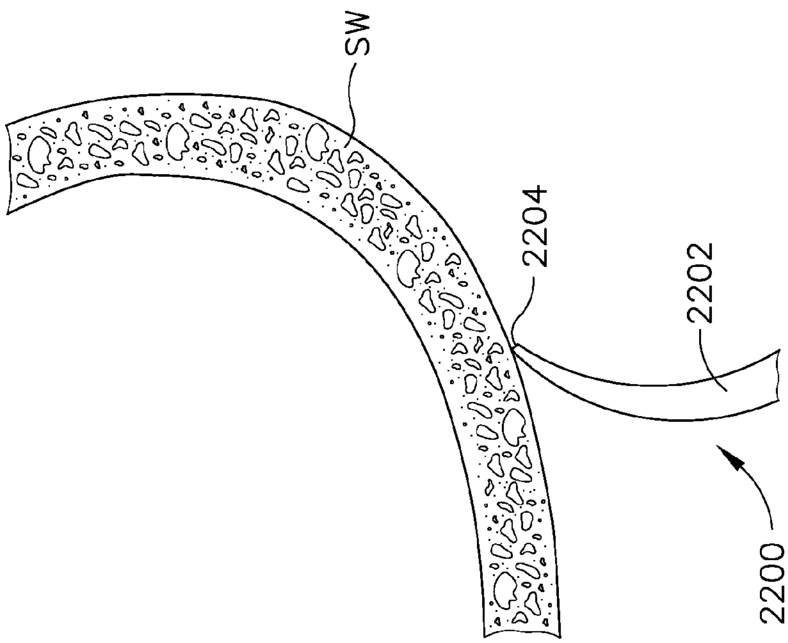

Fig.27A

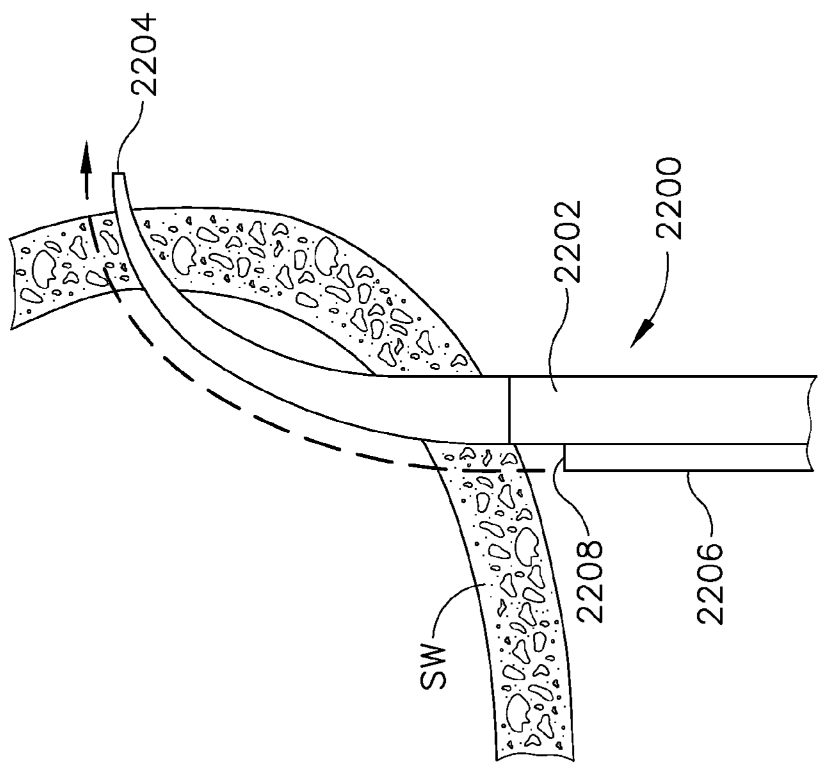

Fig.27C

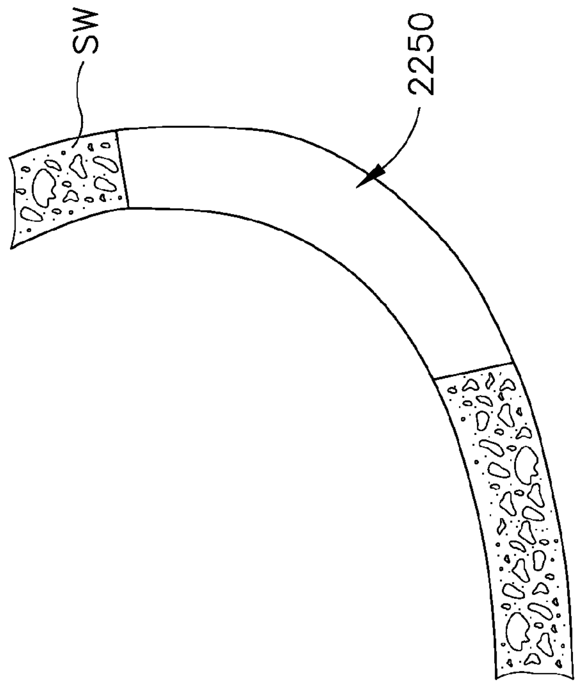

Fig.27D

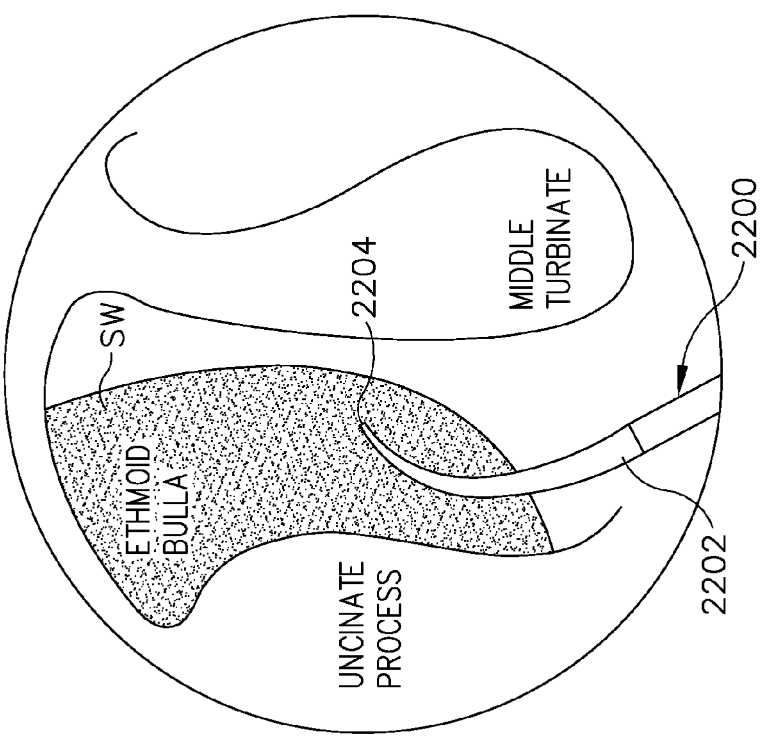

Fig.28A

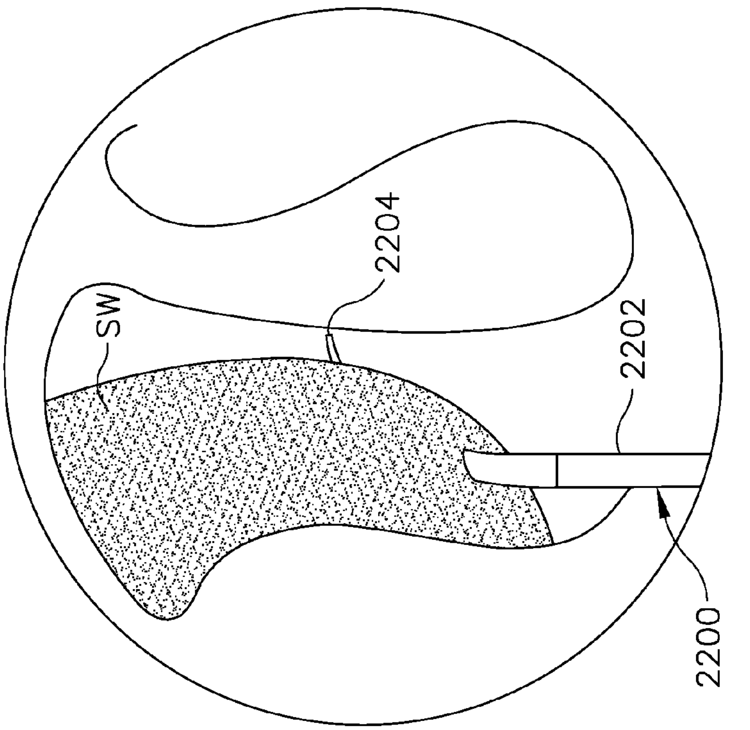

Fig.28B

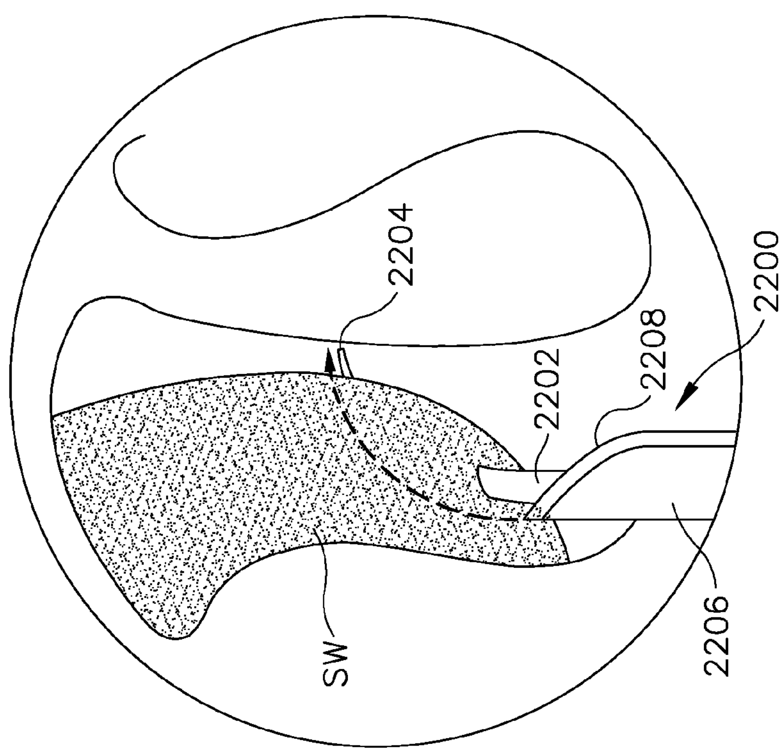

Fig.28C

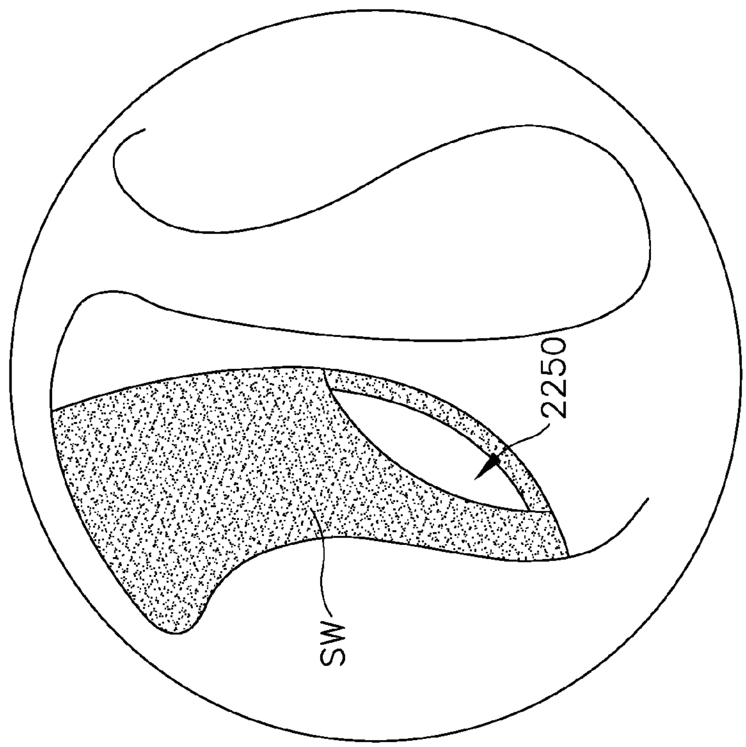

Fig.28D

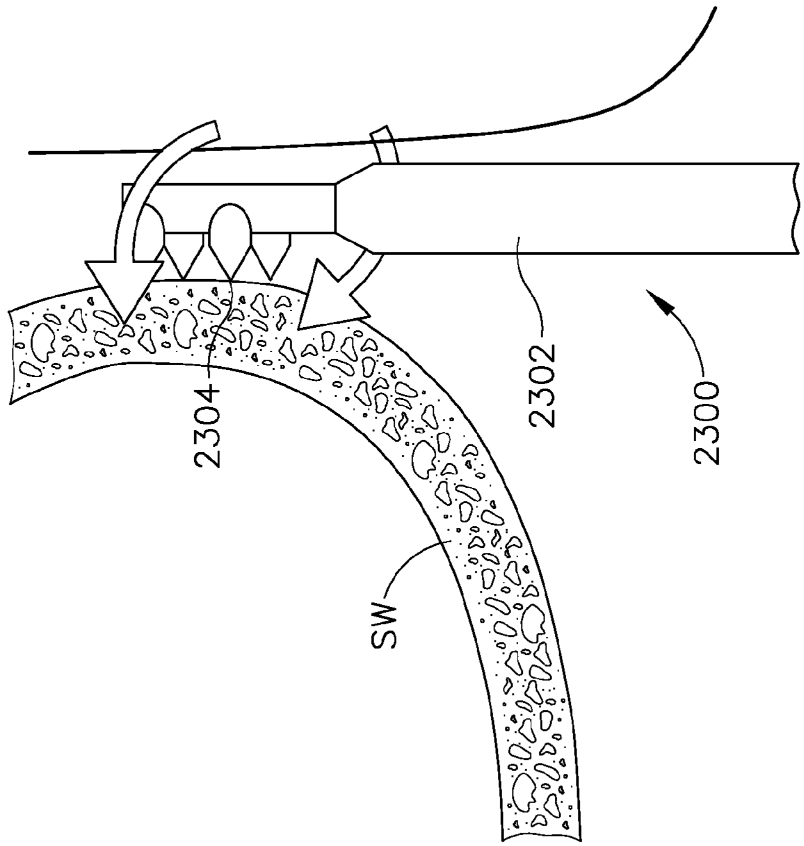

Fig.29B

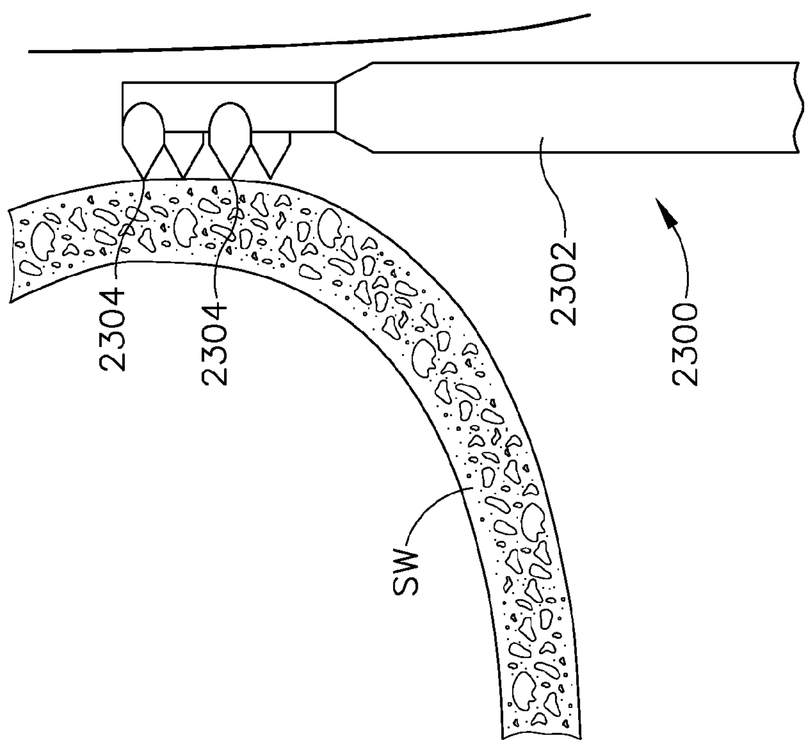

Fig.29A

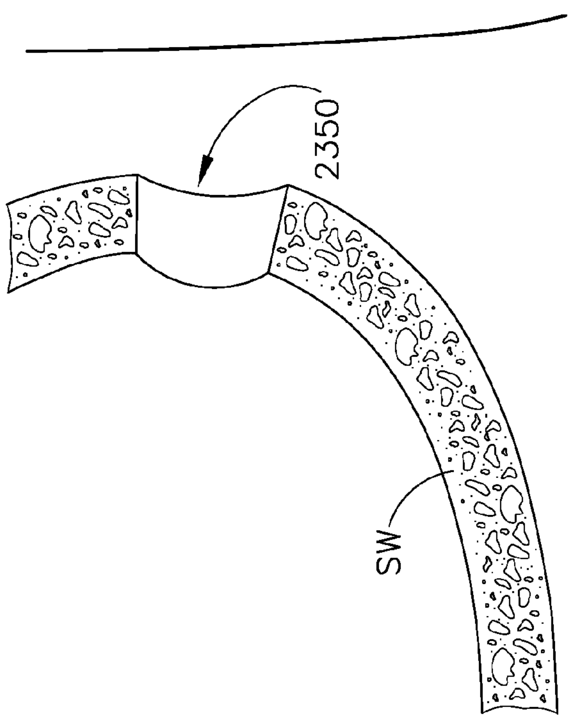

Fig.29D

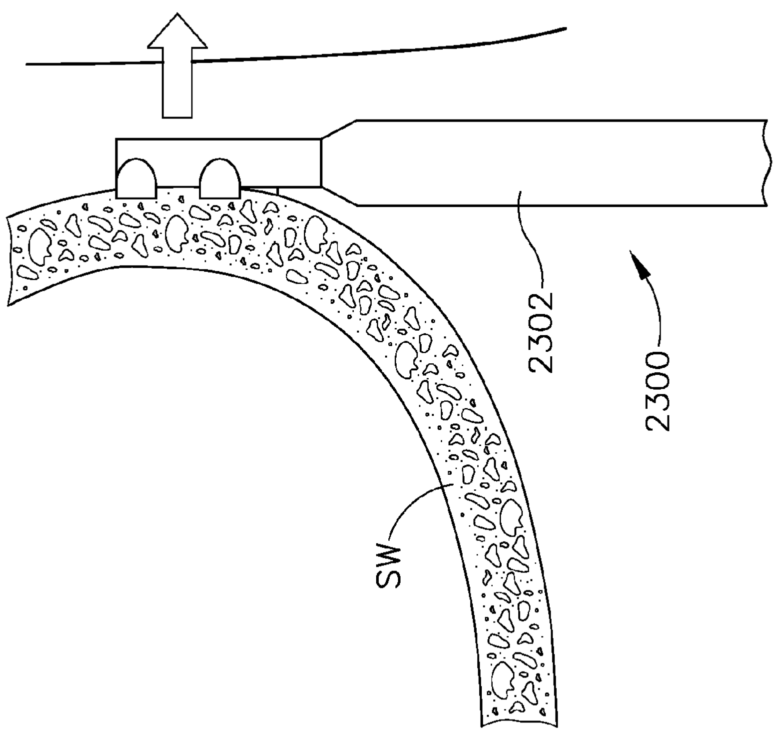

Fig.29C

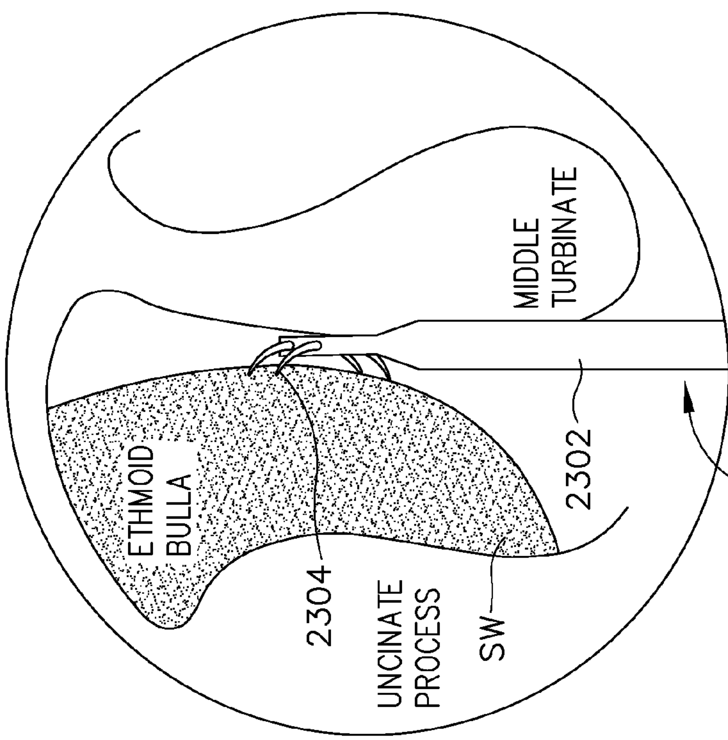

Fig.30A

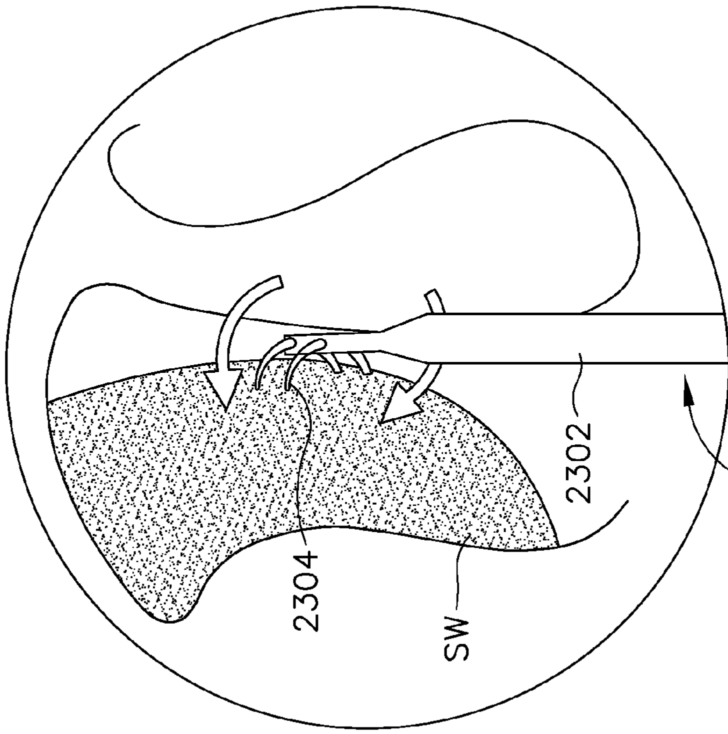

Fig.30B

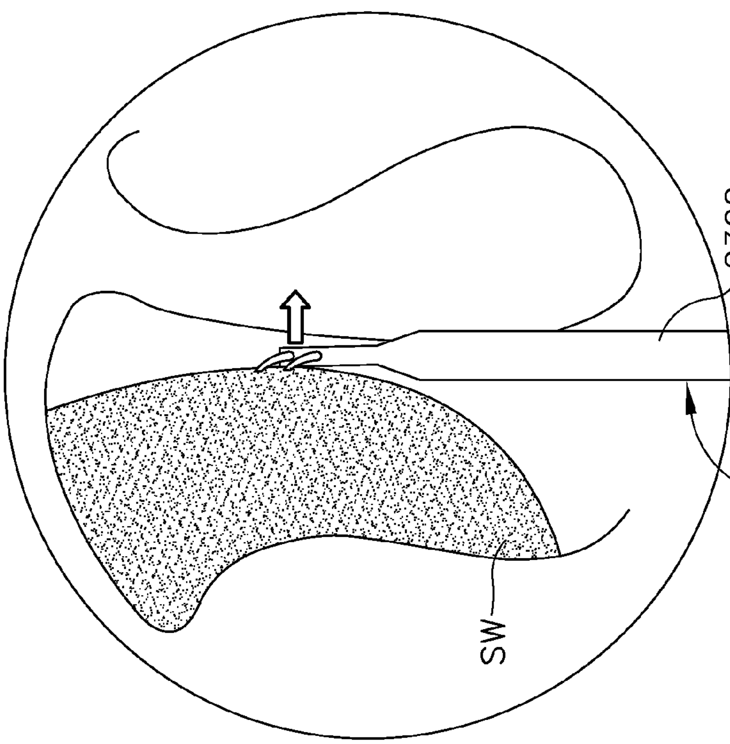

Fig.30C

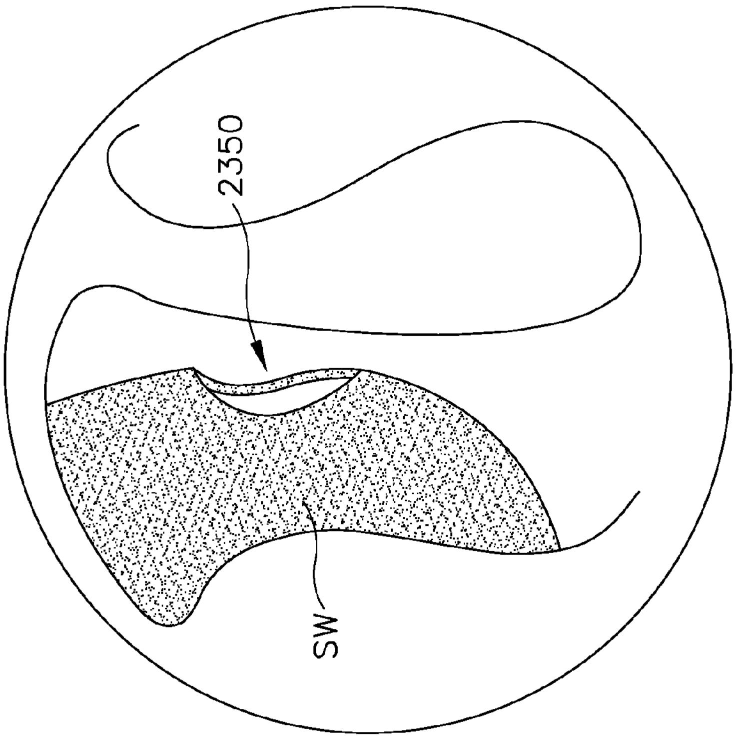

Fig.30D

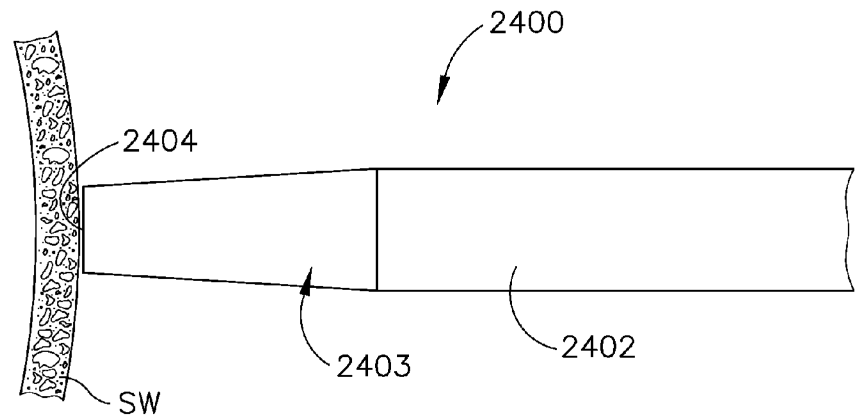

Fig.31A

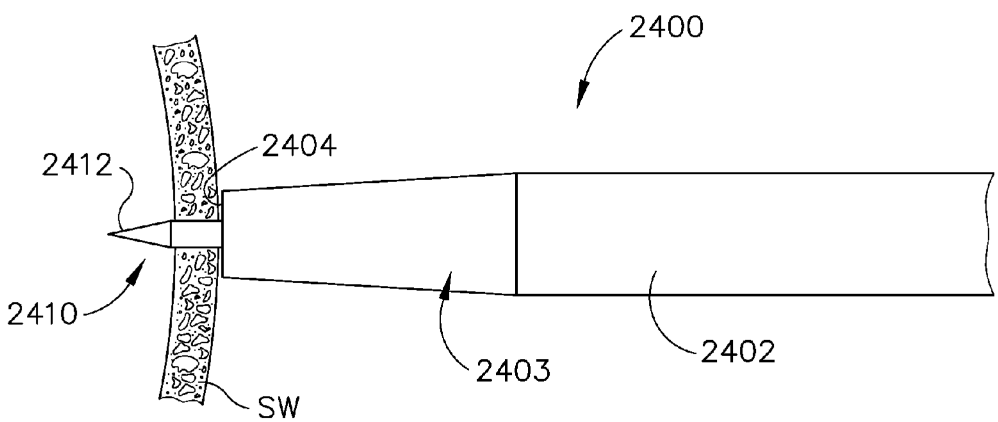

Fig.31B

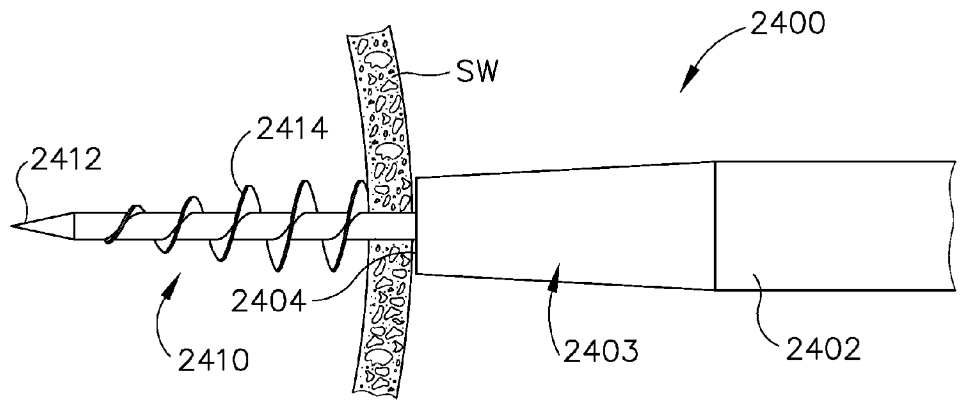

Fig.31C

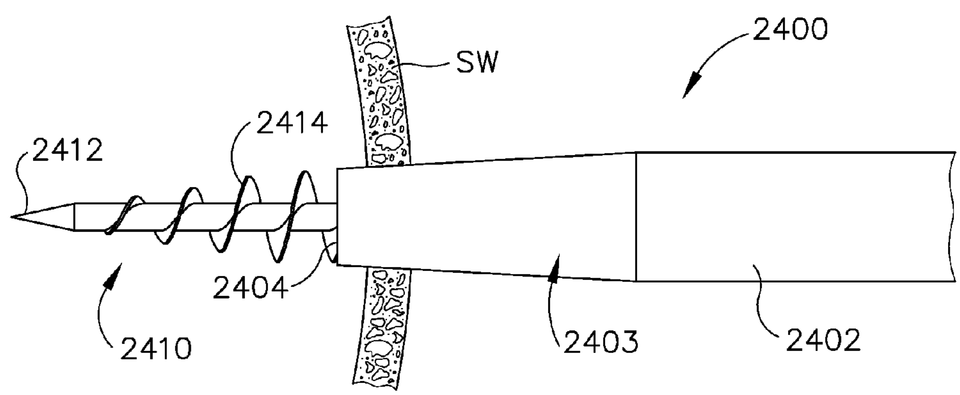

Fig.31D

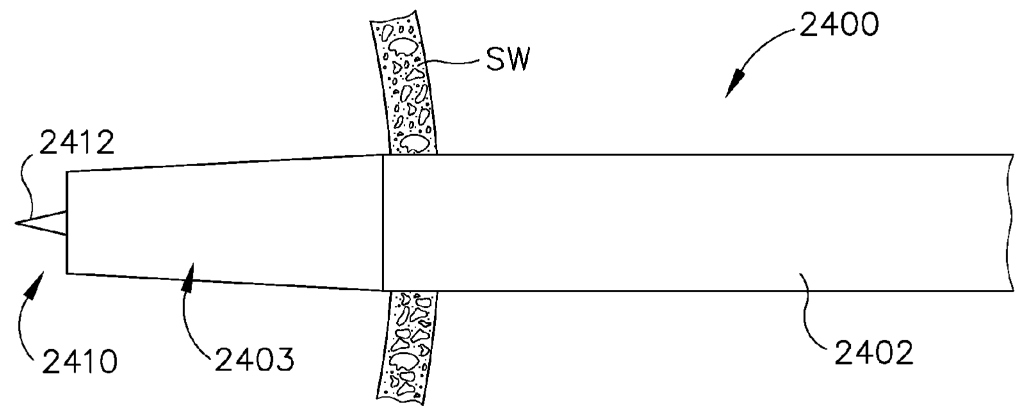

Fig.31E

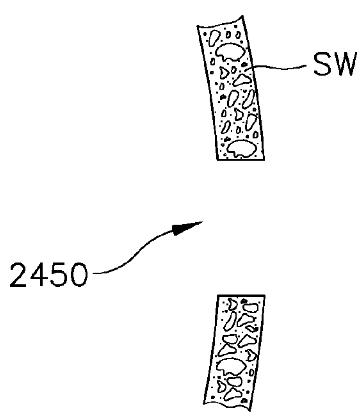

Fig.31F

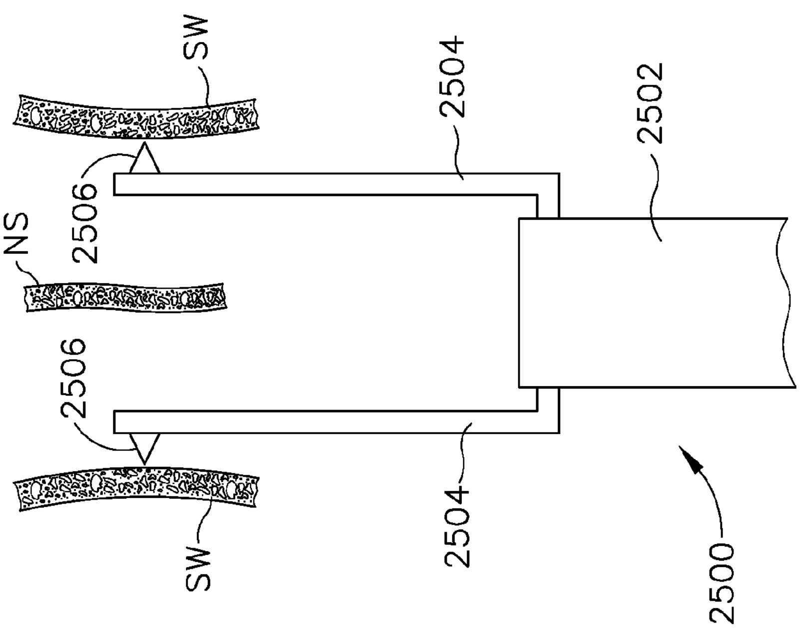

Fig.32A

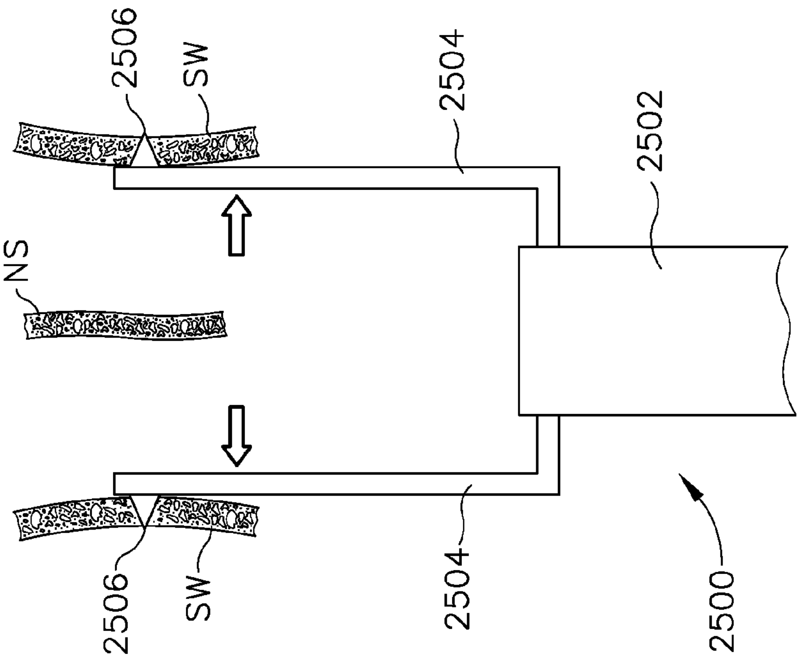

Fig.32B

APPARATUS AND METHOD FOR TREATMENT OF ETHMOID SINUSITIS

BACKGROUND

In some instances, it may be desirable to dilate an anatomical passageway in a patient. This may include dilation of ostia of paranasal sinuses (e.g., to treat sinusitis), dilation of the larynx, dilation of the Eustachian tube, dilation of other passageways within the ear, nose, or throat, etc. One method of dilating anatomical passageways includes using a guide wire and catheter to position an inflatable balloon within the anatomical passageway, then inflating the balloon with a fluid (e.g., saline) to dilate the anatomical passageway. For instance, the expandable balloon may be positioned within an ostium at a paranasal sinus and then be inflated, to thereby dilate the ostium by remodeling the bone adjacent to the ostium, without requiring incision of the mucosa or removal of any bone. The dilated ostium may then allow for improved drainage from and ventilation of the affected paranasal sinus. A system that may be used to perform such procedures may be provided in accordance with the teachings of U.S. Pub. No. 2011/0004057, entitled "Systems and Methods for Transnasal Dilation of Passageways in the Ear, Nose or Throat," published Jan. 6, 2011, the disclosure of which is incorporated by reference herein. An example of such a system is the Relieva® Spin Balloon Sinuplasty™ System by Acclarent, Inc. of Menlo Park, Calif.

A variable direction view endoscope may be used with such a system to provide visualization within the anatomical passageway (e.g., the ear, nose, throat, paranasal sinuses, etc.) to position the balloon at desired locations. A variable direction view endoscope may enable viewing along a variety of transverse viewing angles without having to flex the shaft of the endoscope within the anatomical passageway. Such an endoscope that may be provided in accordance with the teachings of U.S. Pub. No. 2010/0030031, entitled "Swing Prism Endoscope," published Feb. 4, 2010, the disclosure of which is incorporated by reference herein. An example of such an endoscope is the Acclarent Cyclops™ Multi-Angle Endoscope by Acclarent, Inc. of Menlo Park, Calif.

While a variable direction view endoscope may be used to provide visualization within the anatomical passageway, it may also be desirable to provide additional visual confirmation of the proper positioning of the balloon before inflating the balloon. This may be done using an illuminating guidewire. Such a guidewire may be positioned within the target area and then illuminated, with light projecting from the distal end of the guidewire. This light may illuminate the adjacent tissue and thus be visible to the naked eye from outside the patient through transcutaneous illumination. For instance, when the distal end is positioned in the maxillary sinus, the light may be visible through the patient's cheek. Using such external visualization to confirm the position of the guidewire, the balloon may then be advanced distally along the guidewire into position at the dilation site. Such an illuminating guidewire may be provided in accordance with the teachings of U.S. Pub. No. 2012/0078118, entitled "Sinus Illumination Lightwire Device," published Mar. 29, 2012, now U.S. Pat. No. 9,155,492, issued Oct. 13, 2015, the disclosure of which is incorporated by reference herein. An example of such an illuminating guidewire is the Relieva Luma Sentry™ Sinus Illumination System by Acclarent, Inc. of Menlo Park, Calif.

While several instruments and procedures have been made and used for treatment of anatomical passageways in a patient, it is believed that no one prior to the inventors has made or used the invention described in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims which particularly point out and distinctly claim the invention, it is believed the present invention will be better understood from the following description of certain examples taken in conjunction with the accompanying drawings, in which like reference numerals identify the same elements and in which:

FIG. **1** depicts a side elevational view of an exemplary dilation catheter system;

FIG. **2** depicts a side elevational view of an exemplary illuminating guidewire suitable for use with the dilation catheter system of FIG. **1**;

FIG. **3** depicts a side cross-sectional view of the illuminating guidewire of FIG. **2**;

FIG. **4** depicts depicts a perspective view of an exemplary endoscope suitable for use with the dilation catheter system of FIG. **1**;

FIG. **5** depicts a side elevational view of the distal end of the endoscope of FIG. **5**, showing an exemplary range of viewing angles;

FIG. **6** depicts a left sagittal cross-sectional view of a portion of a human head, showing paranasal sinus structures;

FIG. **7**A depicts a left sagittal cross-sectional view of a portion of a human head, with an exemplary port deployment instrument piercing a wall of the ethmoid bulla;

FIG. **7**B depicts a left sagittal cross-sectional view of a portion of a human head, with a port disposed in the pierced wall of the ethmoid bulla;

FIG. **8**A depicts a left sagittal cross-sectional view of a portion of a human head, with another exemplary port deployment instrument piercing a wall of the ethmoid bulla;

FIG. **8**B depicts a left sagittal cross-sectional view of a portion of a human head, with a sheath of the instrument of FIG. **8**A disposed in the pierced wall of the ethmoid bulla, and with a piercing obturator removed from the sheath;

FIG. **8**C depicts a left sagittal cross-sectional view of a portion of a human head, with a suction and irrigation device positioned in the ethmoid bulla via the sheath of FIG. **8**B;

FIG. **8**D depicts a left sagittal cross-sectional view of a portion of a human head, with a port disposed in the pierced wall of the ethmoid bulla;

FIG. **9**A depicts a left sagittal cross-sectional view of a portion of a human head, with another exemplary port deployment instrument piercing a wall of the ethmoid bulla;

FIG. **9**B depicts a left sagittal cross-sectional view of a portion of a human head, with a secondary piercing element extended from the instrument of FIG. **9**A to pierce the wall of the ethmoid bulla in a second location;

FIG. **9**C depicts a left sagittal cross-sectional view of a portion of a human head, with a port disposed in both of the pierced walls of the ethmoid bulla;

FIG. **10** depicts a top plan view of an exemplary port suitable for installation in a wall of an ethmoid bulla;

FIG. **11** depicts a top plan view of another exemplary port suitable for installation in a wall of an ethmoid bulla;

FIG. **12** depicts a top plan view of another exemplary port suitable for installation in a wall of an ethmoid bulla;

FIG. **13** depicts a side elevational view of another exemplary port suitable for installation in a wall of an ethmoid bulla;

FIG. **14** depicts a left sagittal cross-sectional view of a portion of a human head, with an exemplary wick installed in the ethmoid bulla;

FIG. **15** depicts a left sagittal cross-sectional view of a portion of a human head, with an exemplary wick installed across a series of ethmoid sinus cells;

FIG. **16**A depicts a left sagittal cross-sectional view of a portion of a human head, with an exemplary wick passed through the ethmoid bulla in a first stage of installation;

FIG. **16**B depicts a left sagittal cross-sectional view of a portion of a human head, with the wick of FIG. **16**A passed through an additional ethmoid sinus cell and the sphenoid sinus in a second stage of installation;

FIG. **17** depicts a perspective view of an exemplary ethmoid port with a wick having a clamping feature;

FIG. **18** depicts a left sagittal cross-sectional view of a portion of a human head, along a plane medial to the plane associated with the view of FIG. **6**, with the port of FIG. **17** installed in the ethmoid bulla and with the clamping feature engaged with the middle turbinate;

FIG. **19**A depicts a left sagittal cross-sectional view of a portion of a human head, showing the retrobullar space in a non-dilated configuration;

FIG. **19**B depicts a left sagittal cross-sectional view of a portion of a human head, with a guide catheter positioned at the retrobullar space;

FIG. **19**C depicts a left sagittal cross-sectional view of a portion of a human head, with a dilation catheter advanced through the guide catheter of FIG. **19**B into the retrobullar space;

FIG. **19**D depicts a left sagittal cross-sectional view of a portion of a human head, with a dilator of the dilation catheter of FIG. **19**C in an inflated state in the retrobullar space;

FIG. **19**E depicts a left sagittal cross-sectional view of a portion of a human head, showing the retrobullar space in a dilated configuration;

FIG. **20** depicts a perspective view of an exemplary dilation catheter and catheter suitable for dilating an ethmoid bulla ostium;

FIG. **21**A depicts a side elevational view of exemplary piercing catheter, with support balloons in a non-inflated state and with a piercing element in a retracted state;

FIG. **21**B depicts a side elevational view of the piercing catheter of FIG. **21**A, with the support balloons in an inflated state and with the piercing element in the retracted state;

FIG. **21**C depicts a side elevational view of the piercing catheter of FIG. **21**A, with the support balloons in an inflated state and with the piercing element in an advanced state;

FIG. **22**A depicts a left sagittal cross-sectional view of a portion of a human head, with a guide catheter positioned at the retrobullar space;

FIG. **22**B depicts a left sagittal cross-sectional view of a portion of a human head, with the piercing catheter of FIG. **21**A advanced through the guide catheter into the retrobullar space;

FIG. **22**C depicts a left sagittal cross-sectional view of a portion of a human head, with the balloons of the piercing catheter of FIG. **21**A in an inflated state in the retrobullar space;

FIG. **22**D depicts a left sagittal cross-sectional view of a portion of a human head, with the piercing element of the piercing catheter of FIG. **21**A advanced to pierce a posterior wall of the ethmoid bulla;

FIG. **22**E depicts a left sagittal cross-sectional view of a portion of a human head, showing the pierced posterior wall of the ethmoid bulla;

FIG. **23** depicts a side elevational view of an exemplary alternative piercing catheter;

FIG. **24** depicts a side elevational view of another exemplary alternative piercing catheter;

FIG. **25** depicts a perspective view of the distal end of an exemplary alternative sinus wall piercing element;

FIG. **26**A depicts an elevational view of the distal end of another exemplary alternative sinus wall piercing instrument positioned adjacent to a sinus wall, with the sinus wall in cross section, and with a piercing element in a retracted position;

FIG. **26**B depicts an elevational view of the distal end of the piercing instrument of FIG. **26**A, with the sinus wall in cross section, and with the piercing element advanced through the sinus wall;

FIG. **26**C depicts an elevational view of the distal end of the piercing instrument of FIG. **26**A, with the sinus wall in cross section, and with the piercing element being reciprocated in the sinus wall;

FIG. **26**D depicts a cross-sectional view of the sinus wall of FIG. **26**A after completion of a procedure with the piercing instrument of FIG. **26**A;

FIG. **27**A depicts an elevational view of the distal end of another exemplary alternative sinus wall piercing instrument positioned adjacent to a sinus wall, with the sinus wall in cross section, and with a wall cutter retracted out of view;

FIG. **27**B depicts an elevational view of the distal end of the piercing instrument of FIG. **27**A, with the sinus wall in cross section, with the piercing element advanced through the sinus wall, and with the wall cutter retracted out of view;

FIG. **27**C depicts an elevational view of the distal end of the piercing instrument of FIG. **27**A, with the sinus wall in cross section, with the piercing element advanced through the sinus wall, and with the wall cutter being advanced toward the sinus wall;

FIG. **27**D depicts a cross-sectional view of the sinus wall of FIG. **27**A after completion of a procedure with the piercing instrument of FIG. **27**A;

FIG. **28**A depicts a perspective view of the distal end of the piercing element of FIG. **27**A positioned adjacent to the sinus wall, with the wall cutter retracted out of view;

FIG. **28**B depicts a perspective view of the distal end of the piercing element of FIG. **27**A, with the piercing element advanced through the sinus wall, and with the wall cutter retracted out of view;

FIG. **28**C depicts a perspective view of the distal end of the piercing element of FIG. **27**A, with the piercing element advanced through the sinus wall, and with the wall cutter being advanced toward the sinus wall;

FIG. **28**D depicts a perspective view of the sinus wall of FIG. **27**A after completion of a procedure with the piercing instrument of FIG. **27**A;

FIG. **29**A depicts an elevational view of the distal end of another exemplary alternative sinus wall piercing instrument positioned adjacent to a sinus wall, with the sinus wall in cross section;

FIG. **29**B depicts an elevational view of the distal end of the piercing instrument of FIG. **29**A, with the sinus wall in cross section, with piercing elements advanced through the sinus wall;

FIG. **29**C depicts an elevational view of the distal end of the piercing instrument of FIG. **29**A, with the sinus wall in cross section, with the instrument being pulled away from the sinus wall while the piercing elements are disposed in the sinus wall;

FIG. **29**D depicts a cross-sectional view of the sinus wall of FIG. **29**A after completion of a procedure with the piercing instrument of FIG. **29**A;

FIG. **30**A depicts a perspective view of the distal end of the piercing element of FIG. **29**A, with the piercing elements adjacent to the sinus wall;

FIG. **30**B depicts a perspective view of the distal end of the piercing element of FIG. **29**A, with piercing elements advanced through the sinus wall;

FIG. **30**C depicts a perspective view of the distal end of the piercing element of FIG. **29**A, with the instrument being pulled away from the sinus wall while the piercing elements are disposed in the sinus wall;

FIG. **30**D depicts a perspective view of the sinus wall of FIG. **29**A after completion of a procedure with the piercing instrument of FIG. **29**A;

FIG. **31**A depicts an elevational view of the distal end of another exemplary alternative sinus wall piercing instrument positioned adjacent to a sinus wall, with the sinus wall in cross section;

FIG. **31**B depicts an elevational view of the distal end of the piercing instrument of FIG. **31**A, with the sinus wall in cross section, and with the tip of an auger member disposed in the sinus wall;

FIG. **31**C depicts an elevational view of the distal end of the piercing instrument of FIG. **31**A, with the sinus wall in cross section, and with the auger member advanced through the sinus wall;

FIG. **31**D depicts an elevational view of the distal end of the piercing instrument of FIG. **31**A, with the sinus wall in cross section, and with an outer cutter member partially advanced through the sinus wall;

FIG. **31**E depicts an elevational view of the distal end of the piercing instrument of FIG. **31**A, with the sinus wall in cross section, and with an outer cutter member fully advanced through the sinus wall;

FIG. **31**F depicts a cross-sectional view of the sinus wall of FIG. **31**A after completion of a procedure with the piercing instrument of FIG. **31**A;

FIG. **32**A depicts an elevational view of the distal end of another exemplary alternative sinus wall piercing instrument positioned adjacent to a sinus wall, with the sinus wall in cross section, and with arms of the instrument in retracted positions; and

FIG. **32**B depicts an elevational view of the distal end of the piercing instrument of FIG. **32**A, with the sinus wall in cross section, and the with the arms of the instrument in laterally advanced positions.

The drawings are not intended to be limiting in any way, and it is contemplated that various embodiments of the invention may be carried out in a variety of other ways, including those not necessarily depicted in the drawings. The accompanying drawings incorporated in and forming a part of the specification illustrate several aspects of the present invention, and together with the description serve to explain the principles of the invention; it being understood, however, that this invention is not limited to the precise arrangements shown.

DETAILED DESCRIPTION

The following description of certain examples of the technology should not be used to limit its scope. Other examples, features, aspects, embodiments, and advantages of the technology will become apparent to those skilled in the art from the following description, which is by way of illustration, one of the best modes contemplated for carrying out the technology. As will be realized, the technology described herein is capable of other different and obvious aspects, all without departing from the technology. Accordingly, the drawings and descriptions should be regarded as illustrative in nature and not restrictive.

It will be appreciated that the terms "proximal" and "distal" are used herein with reference to a clinician gripping a handpiece assembly. Thus, an end effector is distal with respect to the more proximal handpiece assembly. It will be further appreciated that, for convenience and clarity, spatial terms such as "top" and "bottom" also are used herein with respect to the clinician gripping the handpiece assembly. However, surgical instruments are used in many orientations and positions, and these terms are not intended to be limiting and absolute.

It is further understood that any one or more of the teachings, expressions, versions, examples, etc. described herein may be combined with any one or more of the other teachings, expressions, versions, examples, etc. that are described herein. The following-described teachings, expressions, versions, examples, etc. should therefore not be viewed in isolation relative to each other. Various suitable ways in which the teachings herein may be combined will be readily apparent to those of ordinary skill in the art in view of the teachings herein. Such modifications and variations are intended to be included within the scope of the claims.

I. Overview of Exemplary Dilation Catheter System

FIG. **1** shows an exemplary dilation catheter system (**10**) that may be used to dilate the ostium of a paranasal sinus; or to dilate some other anatomical passageway (e.g., within the ear, nose, or throat, etc.). Dilation catheter system (**10**) of this example comprises a dilation catheter (**20**), a guide catheter (**30**), an inflator (**40**), and a guidewire (**50**). By way of example only, dilation catheter system (**10**) may be configured in accordance with at least some of the teachings of U.S. Patent Pub. No. 2011/0004057, the disclosure of which is incorporated by reference herein. In some versions, at least part of dilation catheter system (**10**) is configured similar to the Relieva® Spin Balloon Sinuplasty™ System by Acclarent, Inc. of Menlo Park, Calif.

The distal end of dilation catheter (**20**) includes an inflatable dilator (**22**). The proximal end of dilation catheter (**20**) includes a grip (**24**), which has a lateral port (**26**) and an open proximal end (**28**). Dilation catheter (**20**) includes a first lumen (not shown) that provides fluid communication between lateral port (**26**) and the interior of dilator (**22**). Dilator catheter (**20**) also includes a second lumen (not shown) that extends from open proximal end (**28**) to an open distal end that is distal to dilator (**22**). This second lumen is configured to slidably receive guidewire (**50**). The first and second lumens of dilator catheter (**20**) are fluidly isolated from each other. Thus, dilator (**22**) may be selectively inflated and deflated by communicating fluid along the first lumen via lateral port (**26**) while guidewire (**50**) is positioned within the second lumen. In some versions, dilator catheter (**20**) is configured similar to the Relieva Ultirra™ Sinus Balloon Catheter by Acclarent, Inc. of Menlo Park, Calif. In some other versions, dilator catheter (**20**) is configured similar to the Relieva Solo Pro™ Sinus Balloon Catheter by Acclarent, Inc. of Menlo Park, Calif. Other suitable forms that dilator catheter (**20**) may take will be apparent to those of ordinary skill in the art in view of the teachings herein.

Guide catheter (**30**) of the present example includes a bent distal end (**32**) and a grip (**34**) at its proximal end. Grip (**34**) has an open proximal end (**36**). Guide catheter (**30**) defines a lumen that is configured to slidably receive catheter (**20**), such that guide catheter (**30**) may guide dilator (**22**) out through bent distal end (**32**). In some versions, guide catheter (**30**) is configured similar to the Relieva Flex™ Sinus Guide Catheter by Acclarent, Inc. of Menlo Park, Calif. Other suitable forms that guide catheter (**30**) may take will be apparent to those of ordinary skill in the art in view of the teachings herein.

Inflator (**40**) of the present example comprises a barrel (**42**) that is configured to hold fluid and a plunger (**44**) that is configured to reciprocate relative to barrel (**42**) to selectively discharge fluid from (or draw fluid into) barrel (**42**). Barrel (**42**) is fluidly coupled with lateral port (**26**) via a flexible tube (**46**). Thus, inflator (**40**) is operable to add fluid to dilator (**22**) or withdraw fluid from dilator (**22**) by translating plunger (**44**) relative to barrel (**42**). In the present example, the fluid communicated by inflator (**40**) comprises saline, though it should be understood that any other suitable fluid may be used. In some versions, inflator (**40**) is configured in accordance with at least some of the teachings of U.S. Pat. App. No. 61/725,523, entitled "Inflator for Dilation of Anatomical Passageway," filed Nov. 13, 2012, the disclosure of which is incorporated by reference herein. Other suitable forms that inflator (**40**) may take will be apparent to those of ordinary skill in the art in view of the teachings herein.

As best seen in FIGS. **2-3**, guidewire (**50**) of the present example comprises a coil (**52**) positioned about a core wire (**54**). An illumination wire (**56**) extends along the interior of core wire (**54**) and terminates in an atraumatic lens (**58**). A connector (**55**) at the proximnal end of guidewire (**50**) enables optical coupling between illumination wire (**56**) and a light source (not shown). Illumination wire (**56**) may comprise one or more optical fibers. Lens (**58**) is configured to project light when illumination wire (**56**) is illuminated by the light source, such that illumination wire (**56**) transmits light from the light source to the lens (**58**). In some versions, the distal end of guidewire (**50**) is more flexible than the proximal end of guidewire (**50**). Guidewire (**50**) has a length enabling the distal end of guidewire (**50**) to be positioned distal to dilator (**22**) while the proximal end of guidewire (**50**) is positioned proximal to grip (**24**). Guidewire (**50**) may include indicia along at least part of its length (e.g., the proximal portion) to provide the operator with visual feedback indicating the depth of insertion of guidewire (**50**) relative to dilation catheter (**20**). By way of example only, guidewire (**50**) may be configured in accordance with at least some of the teachings of U.S. Pub. No. 2012/0078118, now U.S. Pat. No. 9,155,492, the disclosure of which is incorporated by reference herein. In some versions, guidewire (**50**) is configured similar to the Relieva Luma Sentry™ Sinus Illumination System by Acclarent, Inc. of Menlo Park, Calif. Other suitable forms that guidewire (**50**) may take will be apparent to those of ordinary skill in the art in view of the teachings herein.

In an exemplary dilation procedure, guide catheter (**30**) may first be positioned near the targeted anatomical passageway, such as a sinus ostium (O). Dilator (**22**) and the distal end of guidewire (**50**) may be positioned within or proximal to bent distal end (**32**) of guide catheter (**30**) at this stage. Guide catheter (**30**) is initially inserted into the nose of the patient and is advanced to a position that is within or near the ostium (O) to be dilated. This positioning of guide catheter (**30**) may be performed under visualization provided by an endoscope such as endoscope (**60**) described below. After guide catheter (**30**) has been positioned, the operator may advance guidewire (**50**) distally through guide catheter (**30**) such that a distal portion of the guidewire (**50**) passes through the sinus ostium (O) and into the sinus cavity. The operator may illuminate illumination wire (**56**) and lens (**58**), which may provide transcutaneous illumination through the patient's face to enable the operator to visually confirm positioning of the distal end of guidewire (**50**) with relative ease.

With guide catheter (**30**) and guidewire (**50**) suitably positioned, dilation catheter (**20**) is advanced along guidewire (**50**) and through bent distal end (**32**) of guide catheter (**30**), with dilator (**22**) in a non-dilated state until dilator (**22**) is positioned within the sinus ostium (O) (or some other targeted anatomical passageway). After dilator (**22**) has been positioned within the ostium (O), dilator (**22**) may be inflated, thereby dilating the ostium. To inflate dilator (**22**), plunger (**44**) may be actuated to push saline from barrel (**42**) of inflator (**40**) through dilation catheter (**20**) into dilator (**22**). The transfer of fluid expands dilator (**22**) to an expanded state to open or dilate the ostium (O), such as by remodeling the bone, etc., forming ostium (O). By way of example only, dilator (**22**) may be inflated to a volume sized to achieve about 10 to about 12 atmospheres. Dilator (**22**) may be held at this volume for a few seconds to sufficiently open the ostium (O) (or other targeted anatomical passageway). Dilator (**22**) may then be returned to a non-expanded state by reversing plunger (**44**) of inflator (**40**) to bring the saline back to inflator (**40**). Dilator (**22**) may be repeatedly inflated and deflated in different ostia and/or other targeted anatomical passageways. Thereafter, dilation catheter (**20**), guidewire (**50**), and guide catheter (**30**) may be removed from the patient.

II. Overview of Exemplary Endoscope

As noted above, an endo scope (**60**) may be used to provide visualization within an anatomical passageway (e.g., within the nasal cavity, etc.) during a process of using dilation catheter system (**10**). As shown in FIGS. **4-5**, endoscope of the present example comprises a body (**62**) and a rigid shaft (**64**) extending distally from body (**62**). The distal end of shaft (**64**) includes a curved transparent window (**66**). A plurality of rod lenses and light transmitting fibers may extend along the length of shaft (**64**). A lens is positioned at the distal end of the rod lenses and a swing prism is positioned between the lens and window (**66**). The swing prism is pivotable about an axis that is transverse to the longitudinal axis of shaft (**64**). The swing prism defines a line of sight that pivots with the swing prism. The line of sight defines a viewing angle relative to the longitudinal axis of shaft (**64**). This line of sight may pivot from approximately 0 degrees to approximately 120 degrees, from approximately 10 degrees to approximately 90 degrees, or within any other suitable range. The swing prism and window (**66**) also provide a field of view spanning approximately 60 degrees (with the line of sight centered in the field of view). Thus, the field of view enables a viewing range spanning approximately 180 degrees, approximately 140 degrees, or any other range, based on the pivot range of the swing prism. Of course, all of these values are mere examples.

Body (**62**) of the present example includes a light post (**70**), an eyepiece (**72**), a rotation dial (**74**), and a pivot dial (**76**). Light post (**70**) is in communication with the light transmitting fibers in shaft (**64**) and is configured to couple with a source of light, to thereby illuminate the site in the patient distal to window (**66**). Eyepiece (**72**) is configured to provide visualization of the view captured through window (**66**) via the optics of endoscope (**60**). It should be understood that a visualization system (e.g., camera and display screen, etc.) may be coupled with eyepiece (**72**) to provide visualization of the view captured through window (**66**) via the optics of endoscope (**60**). Rotation dial (**74**) is configured to rotate shaft (**64**) relative to body (**62**) about the longitudinal axis of shaft (**64**). It should be understood that such rotation may be carried out even while the swing prism is pivoted such that the line of sight is non-parallel with the longitudinal axis of shaft (**64**). Pivot dial (**76**) is coupled with the swing prism and is thereby operable to pivot the swing prism about the transverse pivot axis. Indicia (**78**) on body (**62**) provide visual feedback indicating the viewing angle. Various suitable components and arrangements that may be used to couple rotation dial (**74**) with the swing prism will be apparent to those of ordinary skill in the art in view of the teachings herein. By way of example only, endoscope (**60**) may be configured in accordance with at least some of the teachings of U.S. Pub. No. 2010/0030031, the disclosure of which is incorporated by reference herein. In some versions, endoscope (**60**) is configured similar to the Acclarent Cyclops™ Multi-Angle Endoscope by Acclarent, Inc. of Menlo Park, Calif. Other suitable forms that endoscope (**60**) may take will be apparent to those of ordinary skill in the art in view of the teachings herein.

III. Exemplary Port for Ethmoid Sinus

FIG. **6** shows a left sagittal cross-sectional view of a portion of a human head, which includes a sphenoid sinus (SS), ethmoid sinus (ES), frontal sinus (FS), middle turbinate horizontal basal lamella (MThBL), middle turbinate vertical basal lamella (MTvBL), uncinate process (UP), and lateral nasal wall (LNW). The ethmoid sinus (ES) comprises a set of sinus cells that may be categorized as anterior ethmoid sinus (AES) cells and posterior ethmoid sinus (PES) cells. The ethmoid bulla (EB) is the largest ethmoid sinus (ES) cell, and is generally inferior and anterior to the other cells of the ethmoid sinus (ES). The posterior wall of the ethmoid bulla (EB) and the middle turbinate vertical basal lamella (MTvBL) together define a retrobullar space (RBS). It should be understood that anatomical variation in the human is such that this retrobullar space (RBS) may or may not be present in a given individual.

The ethmoid sinus (ES) includes ostia (not shown) for providing fluid communication to and from the cells of the ethmoid sinus (ES) and the nasal cavity. For instance, ostia may provide fluid paths for cells within the anterior ethmoid sinus (AES), cells within the posterior ethmoid sinus (PES), and the ethmoid bulla (EB). In some instances, suprabullar cells of the ethmoid sinus (ES) drain into the ethmoid bulla (EB). Some suprabullar cells may drain directly into the retrobullar space (RBS). The ethmoid bulla (EB) may itself provide fluid communication with the nasal cavity via one or more ostia, such that the ethmoid bulla (EB) may provide a fluid communication path between the other ethmoid sinus (ES) cells (that drain into the ethmoid bulla (EB)) and the nasal cavity. For instance, the ethmoid bulla (EB) may provide fluid communication through an ostium at the retrobullar space (RBS). The fluid communication paths provided by ostia may allow the entry of air and liquids (e.g., medications); while also allowing drainage of mucus. In some instances, the ostia may become blocked, may become functionally closed due to mucosal thickening, or may otherwise not provide sufficient fluid communication. In addition or in the alternative, the configuration of the retrobullar space (RBS) may impede flow through the ostium of the ethmoid bulla (EB).

The anatomy of the ethmoid sinus (ES) may make it impractical to perform a dilation procedure on ostia of the ethmoid sinus (ES) using dilation catheter system (**10**) to improve fluid communication within the ethmoid sinus (ES). This may lead some operators to perform an ethmoidectomy, which is an invasive procedure that involves removal of ethmoid sinus (ES) portions (e.g., tissue and bone) using an instrument such as a debriding instrument. This kind of procedure may be somewhat crude an inelegant, resulting in removal of significant amounts of mucosa that might otherwise benefit the patient. Ethmoidectomy procedures may also have risks of inadvertent damage to optic nerves, damage to orbital muscles, damage to olfactory bulbs, damage to other anatomical structures, and even leakage of cerebrospinal fluid. Even in successful ethmoidectomies, the patient may need to return for several follow-up debridements. It may therefore be desirable to improve fluid communication from within the ethmoid sinus (ES) to the nasal cavity without resorting to a procedure like an ethmoidectomy. In some instances, this may involve implantation of a port in one or more cells of the ethmoid sinus (ES). Several merely illustrative examples of such ports are described in greater detail below, while other examples will be apparent to those of ordinary skill in the art in view of the teachings herein.

A. Exemplary Port with Single Wall Deployment

FIG. **7** shows an exemplary instrument (**100**) that may be used to deploy a port (**200**) in the ethmoid bulla (EB). Instrument (**100**) of this example has a piercing tip (**102**) and an opening (**104**) proximal to tip (**102**). In some versions, the outer diameter of instrument (**100**) is approximately 3 mm, though other dimensions may be used. The mouth of opening (**104**) lies along a plane that is oblique to the longitudinal axis of instrument (**100**) in the present example, though it should be understood that opening (**100**) may instead have other configurations and orientations. Instrument (**100**) may be introduced through the patient's nose (in this case, the patient's right nostril) and positioned at an anterior/inferior wall of the ethmoid bulla (EB). Instrument (**100**) may be positioned using visualization from endoscope (**60**) described above and/or from some other device. A retractable sheath (not shown) may be used to shield tip (**102**) until instrument (**100**) reaches the ethmoid bulla (EB).

Once positioned at the ethmoid bulla (EB), instrument (**100**) may be advanced against the ethmoid bulla (EB) such that tip (**102**) pierces the wall of the ethmoid bulla (EB), allowing opening (**104**) to be positioned within the ethmoid bulla (EB) as shown in FIG. **7**A. Tip (**102**) is configured to pierce the wall of the ethmoid bulla (EB) without shattering the wall of the ethmoid bulla (EB). In other words, the wall of the ethmoid bulla (EB) remains intact except for the opening created by instrument (**100**), with such an opening being approximately the same size as the outer diameter of instrument (**100**). In some versions, tip (**102**) is rotated (e.g., by hand, using a torsion spring, etc.) to assist with piercing of the ethmoid bulla (EB). Such rotation may be in one angular direction or may be in opposing angular directions (e.g., in a rocking motion). In addition or in the alternative, tip (**102**) may be imparted with a reciprocating longitudinal motion. Tip (**102**) may also have an abrasive surface/edge and/or other features that promote piercing of the ethmoid bulla (EB). Various suitable configurations for tip (**102**) and methods for piercing the ethmoid bulla (EB) with tip (**102**) will be apparent to those of ordinary skill in the art in view of the teachings herein.

After instrument (**100**) has pierced the ethmoid bulla (EB), instrument (**100**) may deploy a port (**200**) within the opening created in the wall of the ethmoid bulla (EB) by tip (**102**), as shown in FIG. **7**B. By way of example only, instrument (**100**) may include a translating push-rod or other feature within instrument (**100**) that is able to drive port (**200**) out through opening (**104**). As another merely illustrative example, instrument (**100**) may be configured and operable in accordance with at least some of the teachings of U.S. Pub. No. 2011/0015645, entitled "Tympanic Membrane Pressure Equalization Tube Delivery System," published Jan. 20, 2011, now U.S. Pat. No. 8,864,774, issued Oct. 21, 2014, the disclosure of which is incorporated by reference herein. In such versions, port (**200**) may be generally analogized to the pressure equalization tube deployed in a patient's tympanic membrane. Various other suitable ways in which port (**200**) may be deployed in the wall of the ethmoid bulla (EB) will be apparent to those of ordinary skill in the art in view of the teachings herein.

Port (**200**) of the present example comprises a cylindraceous body (**202**), a first flange (**204**) at one end of body (**202**), and a second flange (**206**) at the other end of body (**202**). Body (**202**) is hollow and defines a lumen (**208**) extending from flange (**204**) to flange (**206**). As shown in FIG. **7**B, flange (**204**) is positioned within the interior of the ethmoid bulla (EB) while flange (**206**) is positioned at the exterior of the ethmoid bulla (EB). Flanges (**204**, **206**) are configured to generally maintain the position of port (**200**) with respect to the ethmoid bulla (EB). Flanges (**204**, **206**) may be separated from each other by any other suitable distance, such that body (**202**) may extend to any suitable length. In some versions, only one flange (**204**, **206**) is provided. For instance, flange (**206**) may be omitted in some versions.

Port (**200**) may be formed of a resilient material, such that port (**200**) is compressed while port (**200**) is within instrument (**100**); with port (**200**) resiliently assuming the rivet like shape shown in FIG. **7**B as soon as port (**200**) exits instrument (**100**). In some other versions, port (**200**) is formed of a malleable material. In some such versions, instrument (**100**) includes features that form the rivet like shape of port (**200**) as port (**200**) is deployed in the wall of ethmoid bulla (EB). It should also be understood that port (**200**) may be formed of a bioabsorbable or biodegradable material. In versions where port (**200**) is formed of a bioabsorbable material, the bioabsorbable material forming port (**200**) may include one or more therapeutic materials. In some versions where port (**200**) is formed of a non-bioabsorbable/non-biodegradable material, port (**200**) may eventually be removed from the patient some time after implantation. Port (**200**) may also be formed of a material that is configured to wick fluids. By way of example only, port (**200**) may be formed of semi-flexible, porous polyethylene, with a pore size selected to optimize wicking and with a surface coating/treatment to make port (**200**) hydrophilic. Various suitable materials that may be used to form port (**200**) will be apparent to those of ordinary skill in the art in view of the teachings herein.

It should be understood that, once port (**200**) has been deployed, lumen (**208**) enables the substantially free communication of air/mucus/etc. into and out of the ethmoid bulla (EB). Port (**200**) thus serves as a substitute or supplemental ostium for the ethmoid bulla (EB). In some instances, the patient may be instructed to periodically self-administer medications or other fluids within their nose after a port (**200**) has been implanted. By way of example only, such fluids/medications may include saline, a combination of saline and a surfactant, an anti-inflammatory (e.g., mometasone, etc.), an antibiotic, an anti-fungal, and/or various other kinds of fluids/medications, including combinations thereof. Lumen (**208**) may provide a substantially clear path for such fluids/medications to reach the mucosa within the ethmoid bulla (EB), in addition to providing a vent/drainage path for the ethmoid bulla (EB). In other words, the presence of port (**200**) may provide substantially greater communication of the administered fluids/medications to the ethmoid bulla (EB) than the communication that would be provided in the absence of port (**200**). In some variations, a sleeve (not shown) extends from flange (**206**) and is in fluid communication with lumen (**208**). Such a sleeve may be directly coupled with a fluid delivery device and/or a suction device to actively deliver fluid or suction to the ethmoid bulla (EB) via port (**200**). In addition or in the alternative, such a sleeve may provide a wicking function similar to the various wicks described in greater detail below.

FIGS. **8**A-**8**D show another exemplary instrument (**300**) that may be used to deploy a port (**200**) in the ethmoid bulla (EB). Instrument (**300**) of this example comprises an outer cannula (**320**) and an obturator (**310**) slidably disposed within outer cannula (**320**). Obturator (**310**) has a sharp tip (**312**) configured to pierce the wall of the ethmoid bulla (EB), with cannula (**320**) trailing behind as shown in FIG. **8**A. Tip (**312**) is configured to pierce the wall of the ethmoid bulla (EB) without shattering the wall of the ethmoid bulla (EB). In other words, the wall of the ethmoid bulla (EB) remains intact except for the opening created by tip (**312**), with that opening being approximately the same diameter as cannula (**320**). Obturator (**310**) may be coupled with a rotary drive, reciprocating drive, and/or any other suitable kind of drive that may assist in driving tip (**312**) through the wall of the ethmoid bulla (EB). Tip (**312**) may also have an abrasive surface/edge and/or other features that promote piercing of the ethmoid bulla (EB). By way of example only, tip (**312**) may be configured in accordance with any of the teachings herein relating to structures operable to pierce the wall of the ethmoid bulla (EB). Various suitable forms that tip (**312**) and associated drive features may take will be apparent to those of ordinary skill in the art in view of the teachings herein. It should also be understood that the wall of the ethmoid bulla (EB) may be reinforced with a backing, as taught elsewhere herein, to prevent the wall from shattering when encountered by tip (**312**). Furthermore, in some instances tip (**312**) may be passed through the wall of the ethmoid bulla (EB) so quickly that the inertia of the bone in the wall provides the effect of a backing support. Regardless of how tip (**312**) successfully passes through the wall of the ethmoid bulla (EB), once tip (**312**) and the distal end of cannula (**320**) are positioned within the ethmoid bulla (EB), obturator (**310**) may be withdrawn from cannula (**320**) as shown in FIG. **8**B.

Next, the operator may advance a dual mode catheter (**330**) through cannula (**320**) into the ethmoid bulla (EB) as shown in FIG. **8**C. Catheter (**330**) of this example includes a suction conduit (**322**) and an irrigation conduit (**326**). Suction conduit (**322**) is coaxially disposed within irrigation conduit (**326**). Suction conduit (**324**) is in fluid communication with a suction source (not shown) and has an open distal end (**324**), such that suction conduit (**324**) is operable to provide suction at distal end (**324**). Irrigation conduit (**326**) is in fluid communication with a fluid source (not shown) and has a plurality of transverse openings (**328**), such that irrigation conduit (**326**) is operable to communicate fluid (e.g. saline) through openings (**328**). Conduits (**322**, **326**) may operate together within the ethmoid bulla (EB) to flush and draw out excess mucus/debris/etc. from within the ethmoid bulla (EB), thereby increasing the effective capacity of the ethmoid bulla (EB) and improving contact between the mucosa and subsequently administered medications.

After dual mode catheter (**330**) has been used to flush out the ethmoid bulla (EB), a port (**200**) may be deployed in the wall of the ethmoid bulla (EB) via cannula (**320**), as shown in FIG. **8**D. Port (**200**) of this example is the same as port (**200**) shown in FIG. **7**B and described above. Various suitable ways in which port (**200**) may be deployed via cannula (**320**) will be apparent to those of ordinary skill in the art in view of the teachings herein. In some other versions, cannula (**320**) is withdrawn from the ethmoid bulla (EB) and a separate instrument is used to deploy port (**200**) in the opening left by cannula (**320**). While instruments (**100**, **300**) have been described above as being used to deploy port (**200**) in the wall of the ethmoid bulla (EB), it should be understood that the same instruments (**100**, **300**) (or variations thereof) may be used to deploy various other devices in the wall of the ethmoid bulla (EB). By way of example only, such alternative devices may include wicks as described below, a combination of port and wick as described below, and/or various other devices. Furthermore, while port (**200**) is described herein as being deployed in the ethmoid bulla (EB), it should be understood that port (**200**) may be deployed in various other sinus cells.

B. Exemplary Port with Dual Wall Deployment

In some instances, it may be desirable to provide more than one effective supplemental ostium in the ethmoid bulla (EB). Providing a plurality of effective supplemental ostia in the ethmoid bulla (EB) may further promote fluid communication into and out of the ethmoid bulla (EB). In some instances, this may be accomplished by deploying a plurality of ports (**200**) as described above in different locations in the ethmoid bulla (EB). Alternatively, a single port may provide a plurality of effective supplemental ostia in the ethmoid bulla (EB). FIGS. **9**A-**9**C show one merely illustrative example of how an instrument (**400**) may be used to deploy a single port (**500**) that provides two effective supplemental ostia in the ethmoid bulla (EB). Instrument (**400**) of this example comprises a rigid first piercing member (**402**). Piercing member (**402**) includes a beveled, open distal end (**404**) that terminates in a sharp tip (**406**). This sharp tip (**406**) may be used to pierce the wall of the ethmoid bulla (EB) as shown in FIG. **9**A. As noted above, a rotating and/or reciprocating motion may be imparted to tip (**406**) in various ways in order to assist tip (**406**) in piercing the wall of the ethmoid bulla (EB). Tip (**406**) may also have an abrasive surface/edge and/or other features that promote piercing of the ethmoid bulla (EB). Tip (**406**) is configured to pierce the wall of the ethmoid bulla (EB) without shattering the wall of the ethmoid bulla (EB). In other words, the wall of the ethmoid bulla (EB) remains intact except for the opening created by piercing member (**402**), with such an opening being approximately the same size as the outer diameter of piercing member (**402**).

Once distal end (**404**) has been positioned within the ethmoid bulla (EB), a second piercing member (**410**) is advanced distally out of distal end (**404**) as shown in FIG. **9**B. Second piercing member (**410**) also has a beveled distal end (**412**) that terminates in a sharp tip (**414**). Sharp tip (**414**) is also configured to pierce the wall of the ethmoid bulla (EB). Tip (**414**) is configured to pierce the wall of the ethmoid bulla (EB) without shattering the wall of the ethmoid bulla (EB). In other words, the wall of the ethmoid bulla (EB) remains intact except for the opening created by second piercing member (**410**), with such an opening being approximately the same size as the outer diameter of second piercing member (**410**). Second piercing member (**410**) is formed of a resilient material such that second piercing member (**410**) is resiliently biased to assume the curved configuration shown in FIG. **9**B. However, second piercing member (**410**) is configured to substantially straighten while fully disposed within first piercing member (**402**). By way of example only, second piercing member (**410**) may comprise nitinol. Various other suitable materials and configurations that may be used to form second piercing member (**410**) will be apparent to those of ordinary skill in the art in view of the teachings herein. Similarly, various suitable ways in which second piercing member (**410**) may be driven relative to first piercing member (**402**) will be apparent to those of ordinary skill in the art in view of the teachings herein. As shown in FIG. **9**B, second piercing member (**410**) pierces the wall of ethmoid bulla (EB) when second piercing member (**410**) is advanced distally, due to the curved configuration of second piercing member. It should therefore be understood that first and second piercing members (**402**, **410**) together form two separate openings in the wall of the ethmoid bulla (EB).

After second piercing member (**412**) has been actuated to form the second opening in the wall of the ethmoid bulla (EB), instrument (**400**) deploys a port (**500**) in the ethmoid bulla (EB), as shown in FIG. **9**C. In some versions, port (**500**) is deployed along the exterior of second piercing member (**412**). Various suitable ways in which port (**500**) may be deployed will be apparent to those of ordinary skill in the art in view of the teachings herein. Port (**500**) of this example comprises a body (**502**) that extends between a first flange (**504**) and second flange (**506**). Flanges (**504**, **506**) are both positioned at the exterior of the ethmoid bulla (EB) when port (**500**) is deployed. Body (**502**) is hollow and defines a lumen (**508**) extending from flange (**504**) to flange (**506**). Body (**502**) also defines a plurality of transverse openings (**512**) that are in fluid communication with lumen (**508**). Thus, fluid (e.g., air, mucus, medication, etc.) may flow through lumen (**508**) and openings (**512**), into and out of the ethmoid bulla (EB), via the effective supplemental ostia created at each flange (**504**, **506**) of port (**500**).

Port (**500**) of this example also includes a corrugated region (**510**) that serves as a length absorbing feature. In particular, corrugated region (**510**) is resiliently biased to assume a compressed configuration, at which port (**500**) has a minimum length. However, corrugated region (**510**) is expandable to increase the effective length of port (**500**). In addition to providing a variable length for port (**500**), corrugated region (**510**) allows port (**500**) to flex such that flanges (**504**, **506**) may be positioned at various orientations relative to each other. Thus, port (**500**) may be readily installed in various positions and configurations without requiring a particular predetermined distance between flanges (**504**, **506**) or orientation of flanges (**504**, **506**). It should be understood that port (**500**) may be formed of any of the various kinds of materials described above in relation to port (**200**).

C. Exemplary Alternative Port Configurations

As shown in FIG. **10**, flange (**206**) of port (**200**) described above has a circular shape. Flange (**204**) of port (**200**) may also have a circular shape. Alternatively, a variety of other shapes may be used. For instance, FIG. **11** shows an exemplary alternative port (**600**) that may be used as a substitute for port (**200**). Port (**600**) of this example that has a plurality of rounded wings or petals (**606**) extending outwardly relative to a lumen (**608**). This array of petals (**606**) may serve as a functional equivalent of flange (**206**), substantially maintaining the position of port (**600**) with respect to the ethmoid bulla (EB). FIG. **12** shows another exemplary alternative port (**700**) that may be used as a substitute for port (**200**). Port (**700**) of this example has a plurality of pointed petals (**706**) extending outwardly relative to a lumen (**708**). Again, petals (**706**) may serve as a functional equivalent of flange (**206**), substantially maintaining the position of port (**700**) with respect to the ethmoid bulla (EB). Other suitable variations of flanges (**204**, **206**) and petals (**606**, **706**) will be apparent to those of ordinary skill in the art in view of the teachings herein.

It should also be understood that flanges (**204**, **206**) and petals (**606**, **706**) may be deformable, such that port (**200**, **600**, **700**) may compress into a substantially cylindraceous shape before port (**200**, **600**, **700**) is deployed in the ethmoid bulla (EB). Furthermore, some versions of port (**200**, **600**, **700**) may have flange (**204**, **206**) or petals (**606**, **706**) only at one end of the body of port (**200**, **600**, **700**), such that the other end of port (**200**, **600**, **700**) is substantially straight without an outwardly protruding feature.

FIG. **13** shows an exemplary port (**800**) that may be used as a substitute for port (**500**) described above. Port (**800**) of this example comprises a body (**802**) with a pair of flanges (**804**, **806**). Body (**802**) defines a lumen (not shown) extending from flange (**804**) to flange (**806**). Body (**802**) also defines a plurality of transverse openings (**812**), similar to transverse openings (**512**) described above, that are in fluid communication with the lumen of body (**802**). Body (**802**) also has a corkscrew configuration in this example and is formed of a resilient material. In particular, body (**802**) is resiliently biased to form a compressed corkscrew configuration; yet may be expanded to increase the effective length of port (**800**). The corkscrew configuration thus serves as a length absorbing feature similar to corrugated region (**510**) of port (**500**). This facilitates deployment of port (**800**) installed in various positions and configurations without requiring a particular predetermined distance between flanges (**804**, **806**). The corksrcrew configuration also enables port (**800**) to be installed with flanges (**804**, **806**) at various orientations relative to each other.

It should be understood that ports (**600**, **700**, **800**) may be formed of any of the various kinds of materials described above in relation to port (**200**). Various other suitable forms that an ethmoid port may take will be apparent to those of ordinary skill in the art in view of the teachings herein. Furthermore, while the foregoing examples are provided in the context of providing a port in the ethmoid bulla (EB), it should be understood that ports may be installed elsewhere within the sinus complex, such as in the sphenoid sinus (SS), in the posterior ethmoid sinus (PES), and/or elsewhere, without necessarily also being installed in the ethmoid bulla (EB). By way of example only, an instrument may be used to form an opening in the middle turbinate vertical basal lamella (MTvBL), medial to the posterior wall of the ethmoid bulla (EB) but lateral to the lateral wall of the vertical basal lamella (MTvBL). A port may then be deployed in that formed opening. In some instances, the port may enter the superior meatus, medial to the posterior ethmoid sinus (PES) cells. In some other instances, the port may enter the anterior-most cell of the posterior ethmoid sinus (PES). In either case, the port may serve to increase ventilation to the posterior ethmoid sinus (PES) cells and allow patient-administered substances to reach the posterior ethmoid sinus (PES) cells. Various other ways in which the above described procedures (and in some cases, instruments) may be modified to provide ports in sinus cells other than the ethmoid bulla (EB) will be apparent to those of ordinary skill in the art in view of the teachings herein.

IV. Exemplary Wick for Ethmoid Sinus

In addition to or as an alternative to deploying a port in the ethmoid bulla (EB), it may be desirable to deploy a wick in the ethmoid bulla (EB) and/or in other sinus cavities. A wick may promote communication of medical fluids to the mucosa of the ethmoid bulla (EB) through a capillary action. This capillary action may be enhanced by maximizing contact between the wick material and the mucosa in the ethmoid bulla (EB). The wick may be bioabsorbable and may itself be formed in part by a therapeutic material. Various examples of intrasinus and intersinus wicks will be described in greater detail below, while other examples will be apparent to those of ordinary skill in the art in view of the teachings herein.

FIG. **14** shows one merely exemplary wick (**1000**) deployed in the ethmoid bulla (EB). By way of example only, an instrument similar to instrument (**100**) or instrument (**400**) may be used to deploy wick (**1000**). Wick (**1000**) of this example comprises a body (**1002**) having a free end (**1004**) and a flange (**1006**). The material forming body (**1002**) is selected to optimize the capillary action provided through body (**1002**). Various suitable materials that may be used to form body (**1002**) will be apparent to those of ordinary skill in the art in view of the teachings herein. Body (**1002**) is shown as being coiled within the ethmoid bulla (EB), and it should be understood that body (**1002**) is in contact with the mucosa of the ethmoid bulla (EB).

Flange (**1006**) is configured to generally secure one end of wick (**1000**) relative to the wall of the ethmoid bulla (EB). It should be understood that flange (**1006**) may be configured similar to flange (**206**), similar to petals (**606**, **706**), or in any other suitable fashion. It should also be understood that flange (**1006**) may simply be omitted in some versions. Flange (**1006**) of the present example defines an opening (**1008**) permitting communication of fluid through flange (**1006**) to reach body (**1002**). For instance, if a patient self-administers a fluid medication into their nose while wick (**1000**) is deployed in the patient's ethmoid bulla (EB), that medication may wick through body (**1002**) to the mucosa of the ethmoid bulla (EB). Wick (**1000**) thus provides a path for the medication that the medication would have otherwise not had, in order to reach the mucosa of the ethmoid bulla (EB).

If desired, a wick may span across more than one sinus cell. For instance, FIG. **15** shows a wick (**1100**) extending along several sinus cells. In particular, wick (**1100**) traverses the ethmoid bulla (EB), traverses two anterior ethmoid sinus (AES) cells, traverses two posterior ethmoid sinus (PES) cells, and terminates at the sphenoid sinus (SS). Wick (**1100**) of this example comprises a body (**1102**) having a first flange (**1104**) at one end and a second flange (**1106**) at the other end. The material forming body (**1102**) is selected to optimize the capillary action provided through body (**1102**). Various suitable materials that may be used to form body (**1102**) will be apparent to those of ordinary skill in the art in view of the teachings herein. When installed as shown, body (**1102**) contacts mucosa in the ethmoid bulla (EB), the anterior ethmoid sinus (AES) cells, and the posterior ethmoid sinus (PES) cells. While body (**1102**) is shown as having a substantially straight configuration while spanning across the ethmoid bulla (EB), the anterior ethmoid sinus (AES) cells, and the posterior ethmoid sinus (PES) cells, it should be understood that body (**1102**) may be more loosely positioned in these cells such that there is substantial contact between body (**1102**) and the mucosa in these cells.

Flange (**1106**) generally secures one end of body (**1102**) at an exterior wall of the ethmoid bulla (EB) while flange

(**1104**) generally secures the other end of body (**1102**) at an interior wall of the sphenoid sinus (SS). Flanges (**1104**, **1106**) may each be configured similar to flange (**206**), similar to petals (**606**, **706**), or in any other suitable fashion. It should also be understood that one or both of flanges (**1104**, **1106**) may simply be omitted in some versions. Each flange (**1104**, **1106**) of the present example defines a respective opening (**1108**, **1110**) permitting communication of fluid through flange (**1104**, **1106**) to reach body (**1102**). For instance, if a patient self-administers a fluid medication into their nose while wick (**1100**) is deployed, that medication may wick through body (**1102**) to the mucosa of the ethmoid bulla (EB), the mucosa of the anterior ethmoid sinus (AES) cells, and the mucosa of the posterior ethmoid sinus (PES) cells; and may further reach the sphenoid sinus (SS). Wick (**1100**) thus provides a path for the medication that the medication would not have otherwise had, in order to reach the mucosa of the ethmoid bulla (EB), the mucosa of the anterior ethmoid sinus (AES) cells, and the mucosa of the posterior ethmoid sinus (PES) cells.

It should also be understood that wick (**1100**) may be installed in numerous other configurations. For instance, wick (**1100**) need not reach all the way to the sphenoid sinus (SS), and may instead terminate in any other sinus cell (e.g., within one of the anterior ethmoid sinus (AES) cells or one of the posterior ethmoid sinus (PES) cells, etc.). Various suitable paths for wick (**1100**) will be apparent for those of ordinary skill in the art in view of the teachings herein. It should also be understood that various instruments may be used to deploy wick (**1100**). By way of example only, an instrument similar to instrument (**100**) or instrument (**400**) may be used to deploy wick (**1100**). Other suitable instruments that may be used to deploy wick (**1100**) will be apparent to those of ordinary skill in the art in view of the teachings herein.

In some instances, a curved needle may be used to deploy a wick. For instance, FIG. **16**A shows an example of a wick (**1200**) that has been driven through the ethmoid bulla (EB) with one pass of a curved needle (not shown). Wick (**1200**) of this example has a body (**1202**), a first free end (**1204**), and a second free end (**1206**). Body (**1202**) may be configured similar to bodies (**1002**, **1102**) described above. The arc of the curved needle enables the needle to pierce and pass through the wall of the ethmoid bulla (EB) twice in a single pass, such that wick (**1200**) enters and exits the ethmoid bulla (EB). In a second pass, the curved needle pierces the middle turbinate vertical basal lamella (MTvBL) to pass through a posterior ethmoid sinus (PES) cell and then through the sphenoid sinus (SS) as shown in FIG. **16**B. Thus, first free end (**1204**) is positioned inferior to the sphenoid sinus (SS), while second free end (**1206**) is positioned anterior to the ethmoid bulla (EB). Ends (**1204**, **1206**) lack flanges, petals, or similar structures in this example. Body (**1202**) contacts mucosa in the ethmoid bulla (EB), the posterior ethmoid sinus (PES) cell, and the sphenoid sinus (SS), such that body (**1202**) is able to deliver medical fluid to these sinus cells through a capillary action. Of course, a curved needle or other device may be used to route a wick (**1200**) in various other routes using any desired number of passes of the needle.

FIG. **17** depicts an example of a wicking port (**1300**) that is essentially a hybrid of the ports and wicks described above. Wicking port (**1300**) of this example includes a wick portion (**1310**) and a port portion (**1320**). As described in greater detail below, wick portion (**1310**) will be positioned anteriorly relative to port portion (**1320**) when wicking port (**1300**) is deployed in a patient. Wicking port (**1300**) is positioned in the particular orientation shown in FIG. **17** merely to illustrate the structural features of wicking port (**1300**), not to represent a deployed orientation. Wick portion (**1310**) includes a generally flat wick body (**1312**) that terminates in a free end (**1314**), with a set of wings (**1316**) at the other end. Body (**1312**) may be configured similar to bodies (**1002**, **1102**) described above. A resilient band (**1318**) is integrated into wick body (**1312**), just proximal to free end (**1314**). Band (**1318**) is resiliently biased to assume a bent clamping configuration as described below; yet band (**1318**) is sufficiently compliant to flex into a substantially straight configuration. Port portion (**1320**) includes a cylindraceous body (**1322**), a flange (**1324**), and a lumen (**1328**). Port portion (**1320**) is substantially similar to port (**200**) described above, except that body (**1322**) is joined to wick portion (**1310**) where body (**202**) has flange (**206**). Lumen (**1328**) is in fluid communication with body (**1312**), such that fluid communicated through lumen (**1328**) may be wicked through body (**1312**); and such that fluid wicked through body (**1312**) may be communicated through lumen (**1328**). In some alternative versions, flange (**1324**) is omitted.

FIG. **18** shows an exemplary deployment of wicking port (**1300**). As shown, port (**1300**) is positioned such that port portion (**1320**) is disposed through the wall of the ethmoid bulla (EB). Wings (**1316**) and flange (**1324**) cooperate to maintain the position of port portion (**1320**) relative to the ethmoid bulla (EB). Body (**1312**) spans across a portion of the nasal cavity to reach the middle turbinate (MT). Body (**1312**) wraps around an anterior ridge of the middle turbinate (MT) and band (**1318**) acts as a clip resiliently securing body (**1312**) to the middle turbinate (MT). Free end (**1314**) of body (**1312**) is positioned at the medial side of the middle turbinate (MT). The positioning of body (**1312**) may substantially increase its saturation with fluids administered through the patient's nose. Fluid from the saturated body (**1312**) may reach the patient's ethmoid bulla (EB) by wicking to port portion (**1320**), where the medical fluid crosses into the ethmoid bulla (EB).

Various suitable ways in which wicking port (**1300**) may be deployed will be apparent to those of ordinary skill in the art in view of the teachings herein. For instance, an instrument similar to instrument (**100**) or instrument (**400**) may be used to first deploy port portion (**1320**), with visualization from endoscope (**60**) and/or some other source of visualization. After port portion (**1320**) is deployed in the ethmoid bulla (EB), a pair of forceps or some other instrument may be used to wrap the free end of wick portion (**1310**) about the anterior ridge of the middle turbinate (MT). A mandrel or other feature may be used to hold band (**1318**) in a straight position before wick portion (**1310**) is appropriately situated in relation to the middle turbinate (MT). Various other suitable instruments and methods that may be used to deploy wicking port (**1300**) will be apparent to those of ordinary skill in the art in view of the teachings herein. It should also be understood that port portion (**1320**) may be installed in a posterior ethmoid sinus (PES) cell or some other location instead of being installed in the ethmoid bulla (EB), if desired. It should also be understood that band (**1318**) and/or other portions of wicking port (**1300**) may be formed of bioabsorbable material, if desired.

While the foregoing examples are provided in the context of providing a wick in the ethmoid bulla (EB), it should be understood that wicks may be installed elsewhere within the sinus complex, such as in the sphenoid sinus (SS), in the posterior ethmoid sinus (PES), and/or elsewhere, without necessarily also being installed in the ethmoid bulla (EB). By way of example only, an instrument may be used to form an opening in the middle turbinate vertical basal lamella (MTvBL), medial to the posterior wall of the ethmoid bulla (EB) but lateral to the lateral wall of the vertical basal lamella (MTvBL). A wick may then be deployed in that formed opening. In some instances, the wick may enter the superior meatus, medial to the posterior ethmoid sinus (PES) cells. In some other instances, the wick may enter the anterior-most cell of the posterior ethmoid sinus (PES). In either case, the wick may allow patient-administered substances to reach the posterior ethmoid sinus (PES) cells. Various other ways in which the above described procedures (and in some cases, instruments) may be modified to provide wicks in sinus cells other than the ethmoid bulla (EB) will be apparent to those of ordinary skill in the art in view of the teachings herein.

V. Exemplary Expansion of Retrobullar Space

As noted above, there may be instances where the configuration of the retrobullar space (RBS) may impede flow through the ostium of the ethmoid bulla (EB). It may therefore be desirable to remodel the retrobullar space (RBS) in order to enlarge the transition zone and thereby improve fluid flow into and out of the ethmoid bulla (EB). FIG. **19**A shows an exemplary retrobullar space (RBS) before a remodeling procedure. FIG. **19**B shows a guide catheter (**1400**) positioned at the retrobullar space (RBS) to begin a remodeling procedure. Guide catheter (**1400**) of this example is similar to guide catheter (**30**) discussed above. Guide catheter (**1400**) includes a body (**1402**) having an open distal end (**1406**) and a bend (**1404**) just proximal to distal end (**1406**). Guide catheter (**1400**) is positioned such that open distal end (**1406**) is positioned at retrobullar space (RBS), anterior to the middle turbinate vertical basal lamella (MTvBL) and posterior to the posterior wall of the ethmoid bulla (EB). Endoscope (**60**) or some other visualization device may be used to assist in positioning of guide catheter (**1400**).

Once guide catheter (**1400**) has been suitably positioned, a balloon catheter (**1410**) is advanced through guide catheter (**1400**) as shown in FIG. **19**C. Balloon catheter (**1410**) has an asymmetrically inflating balloon (**1412**), which is positioned within the retrobullar space (RBS) at this stage, though balloon (**1412**) is in a deflated state during advancement and positioning of balloon catheter (**1410**). While the operator maintains a firm grip on guide catheter (**1400**) and balloon catheter (**1410**), balloon (**1412**) is then inflated as shown in FIG. **19**D. In this example, due to the configuration of balloon (**1412**), rigidity within catheters (**1400**, **1410**), and the operator's firm grip providing a mechanical ground, inflated balloon (**1412**) only bears anteriorly on the ethmoid bulla (EB) and does not bear posteriorly on the middle turbinate vertical basal lamella (MTvBL). Various suitable ways in which balloon (**1412**) may be configured to provide such inflation will be apparent to those of ordinary skill in the art in view of the teachings herein. In the present example, inflated balloon (**1412**) fractures the bone forming the posterior wall of the ethmoid bulla (EB), driving the bone and tissue anteriorly. It should be understood that the fragments formed by fracturing the bone will remain contained within the mucosa, which itself remains intact on both sides of the bone. This is due to the fact that balloon (**1412**) is an atraumatic device used to move the posterior wall of the ethmoid bulla (EB). A traumatic method of remodeling may cause bone fragments to be released in the nasal cavity, which may require the bone fragments to be carefully removed. Such bone fragment removal may be time consuming and difficult. Thus, using balloon (**1412**) may make the remodeling process easier and faster than a procedure that uses a traumatic instrument.

After balloon (**1412**) has been inflated to the point where balloon (**1412**) has remodeled the posterior wall of the ethmoid bulla (EB), balloon (**1412**) is then deflated, and catheters (**1400**, **1410**) are withdrawn from the patient, leaving behind an enlarged retrobullar space (RBS) as shown in FIG. **19**E. This enlarged retrobullar space (RBS) shown in FIG. **19**E may provide greater fluid communication (e.g., mucus outflow) for ethmoid bulla (EB) than the retrobullar space (RBS) shown in FIG. **19**A. In some variations, inflated balloon (**1412**) bears against the middle turbinate vertical basal lamella (MTvBL) in addition to bearing against the posterior wall of the ethmoid bulla (EB). In some such versions, the strength of the middle turbinate vertical basal lamella (MTvBL) is greater than the strength of the posterior wall of the ethmoid bulla (EB), such that the posterior wall of the ethmoid bulla (EB) is remodeled by inflating balloon (**1412**) while the middle turbinate vertical basal lamella (MTvBL) is not remodeled by inflating balloon (**1412**). The vertical basal lamella (MTvBL) may thus provide a mechanical grounding structure for balloon (**1412**) in some instances.

It should be understood that the retrobullar space (RBS) remodeling procedure described above may be performed in addition to or in lieu of deploying ports and/or wicks as described above. It should also be understood that various other kinds of instruments may be used to perform a retrobullar space (RBS) remodeling procedure. By way of example only, catheters (**1400**, **1410**) or instrument (**1500**) may be substituted with a dilation instrument as taught in U.S. patent application Ser. No. 13/832,167, entitled "Uncinate Process Support for Ethmoid Infundibulum Illumination," filed on even date herewith, now U.S. Pat. Pub. No. 2014/0275804, published Sep. 18, 2014, the disclosure of which is incorporated by reference herein.

VI. Exemplary Retrobullar Ostium Dilation

FIG. **20** shows an exemplary instrument (**1500**) that may be used to dilate an ostium of the ethmoid bulla (EB) from within the retrobullar space (RBS). Instrument (**1500**) of this example comprises a guide catheter (**1510**) and a balloon catheter (**1520**). Guide catheter (**1510**) includes a body (**1502**) having an open distal end (**1506**) and a bend (**1504**) just proximal to distal end (**1506**). While guide catheter (**1400**) of the example described above reaches the retrobullar space (RBS) from an inferior approach (with distal end (**1406**) oriented superiorly), guide catheter (**1510**) of this example reaches the retrobullar space (RBS) from a more medial approach (with distal end (**1506**) oriented laterally then anteriorly). Bend (**1504**) of guide catheter (**1510**) also extends along a greater arc angle than bend (**1404**) of guide catheter (**1400**). By way of example only, bend (**1504**) may extend along an arc angle between approximately 135° and approximately 180°. Bend (**1504**) is configured to facilitate orienting distal end (**1506**) directly toward an ostium of the ethmoid bulla (EB) from within the retrobullar space (RBS), anterior to the middle turbinate vertical basal lamella (MTvBL).

Guide catheter (**1510**) of this example also includes a transversely extending reflective member (**1508**). Reflective member (**1508**) is positioned at bend (**1504**) and facilitates viewing of the retrobullar space (RBS) using an endoscope such as endoscope (**60**). In some versions, reflective member (**1508**) may be selectively advanced or retracted transversely relative to body (**1502**). Various suitable ways in which reflective member (**1508**) may be selectively advanced or retracted transversely relative to body (**1502**) will be apparent to those of ordinary skill in the art in view of the teachings herein.

Balloon catheter (**1520**) of the present example includes an inflatable balloon (**1522**) and an atraumatic tip (**1524**) with a rounded/tapered profile that is configured to facilitate insertion into an ostium of the ethmoid bulla (EB). In some versions, balloon catheter (**1520**) is configured to drive tip (**1524**) through an ostium when the effective inner diameter of the ostium is less than the outer diameter of tip (**1524**). Balloon (**1522**) may be configured substantially similar to dilator (**22**) described above. Balloon catheter (**1520**) may be advanced distally through (**1510**) to expose balloon (**1522**) relative to distal end (**1506**). Balloon (**1522**) may then be inflated with fluid from a fluid source (e.g., inflator (**40**), etc.) to expand and thereby dilate an ostium.

In an exemplary use, the operator may position guide catheter (**1510**) such that distal end (**1506**) is oriented directly toward an ostium of the ethmoid bulla (EB) from within the retrobullar space (RBS). During this positioning, the operator may direct the line of sight for endoscope (**60**) (or some other visualization device) at reflective member (**1508**) to obtain a reflected view of the posterior wall of the ethmoid bulla (EB) to visually locate the ostium. Once the guide catheter (**1510**) is suitably positioned, the operator may advance balloon catheter (**1520**) distally through guide catheter (**1510**) such that the tip (**1524**) of balloon catheter (**1520**) passes through the ostium. Again, this may be performed using visualization assistance from reflective member (**1508**). Once balloon (**1522**) is positioned in the ostium, balloon (**1522**) may be inflated with fluid (e.g., from inflator (**40**)) to dilate the ostium. Balloon (**1522**) may be held in an inflated state for any suitable duration. Balloon (**1522**) may be repeatedly inflated and deflated as many times as desired. Once balloon (**1522**) has been finally deflated, balloon (**1522**) may be retracted back into guide catheter (**1510**) and instrument (**1500**) may be removed from the patient's nasal cavity. It should be understood that the retrobullar ostium dilation procedure described above may be performed in addition to or in lieu of deploying ports and/or wicks as described above; and/or in addition to or in lieu of a retrobullar space (RBS) remodeling procedure as described above.

VII. Exemplary Retrobullar Piercing

In addition to or in lieu of installing a port, installing a wick, and/or enlarging the retrobullar space (RBS) by remodeling the posterior wall of the ethmoid bulla (EB), it may be desirable to drive a piercing element into the posterior wall of the ethmoid bulla (EB). In some instances, this may be done to enlarge the size of the naturally occurring ostium that is located at the posterior wall of the ethmoid bulla (EB). In addition or in the alternative, this may be done to create a new ostium for the ethmoid bulla (EB). Whether enlarging an ostium or creating an ostium, this may improve the flow of air and fluid into and out of the ethmoid bulla (EB). Various examples of instruments and procedures that may be used to pierce the posterior wall of the ethmoid bulla (EB) will be described in greater retail below, while other examples will be apparent to those of ordinary skill in the art in view of the teachings herein.

FIGS. **21**A-**21**C show one merely exemplary instrument (**1600**) that may be used to pierce the posterior wall of the ethmoid bulla (EB). Instrument (**1600**) of this example comprises a catheter body (**1602**) having an atraumatic distal tip (**1604**), a distal balloon (**1606**), a proximal balloon (**1608**), and a transverse opening (**1610**) located between balloons (**1606**, **1608**). Balloons (**1606**, **1608**) are coupled with a fluid source (**1632**) via a conduit (**1630**) such that fluid source (**1632**) may selectively communicate fluid (e.g., saline) to balloons (**1606**, **1608**). FIG. **21**A shows balloons (**1606**, **1608**) in a non-inflated state while FIGS. **21**B-**21**C show balloons (**1606**, **1608**) in an inflated state. In the present example, balloons (**1606**, **1608**) are on the same fluid line and are in fluid communication with each other. In some other versions, balloons (**1606**, **1608**) are on independent fluid lines.

Instrument (**1600**) of this example further includes a piercing element (**1620**). Piercing element (**1620**) is slidably disposed within a passageway (**1614**) in catheter body (**1602**). Piercing element (**1620**) includes a sharp distal tip (**1622**). Tip (**1622**) is configured to pierce the wall of the ethmoid bulla (EB) without shattering the wall of the ethmoid bulla (EB). In other words, the wall of the ethmoid bulla (EB) remains intact except for the opening created by piercing element (**1620**), with such an opening being approximately the same size as the outer diameter of piercing element (**1620**). Passageway (**1614**) is fluidly isolated from the fluid path for balloons (**1606**, **1608**). The distal end of passageway includes a ramp (**1612**) leading to transverse opening (**1610**). While ramp (**1612**) is shown as being generally planar, it should be understood that ramp (**1612**) may instead be curved or have some other configuration. Ramp (**1612**) is configured to guide piercing element (**1620**) generally transversely out through transverse opening (**1610**) when piercing element (**1620**) is advanced distally relative to catheter body (**1602**) as shown in FIG. **21**C. In some instances, piercing element (**1620**) is resiliently biased to assume the configuration shown in FIG. **21**C. In some other instances, piercing element (**1620**) is not resiliently biased to assume the configuration shown in FIG. **21**C and is instead driven to that configuration by ramp (**1612**). It should be understood that piercing element (**1620**) is configured such that tip (**1622**) may be positioned outside an outer diameter region defined by inflated balloons (**1606**, **1608**). Tip (**1622**) may thus pass through a tissue wall that is engaged by balloons (**1606**, **1608**), as described below.

FIGS. **22**A-**22**E show a process where instrument (**1600**) is used to pierce the posterior wall of the ethmoid bulla (EB). In particular, FIG. **22**A shows a guide catheter (**1700**) positioned at the retrobullar space (RBS). Guide catheter (**1700**) of this example is substantially identical to guide catheter (**1400**) discussed above. Guide catheter (**1700**) includes a body (**1702**) having an open distal end (**1706**) and a bend (**1704**) just proximal to distal end (**1706**). Guide catheter (**1700**) is positioned such that open distal end (**1706**) is positioned at retrobullar space (RBS), anterior to the middle turbinate vertical basal lamella (MTvBL) and posterior to the posterior wall of the ethmoid bulla (EB). Endoscope (**60**) or some other visualization device may be used to assist in positioning of guide catheter (**1700**).

Once guide catheter (**1700**) has been suitably positioned, instrument (**1600**) is advanced through guide catheter (**1700**) as shown in FIG. **22**B. Balloons (**1606**, **1608**) are both in a deflated state (see also FIG. **21**A) during this advancement of instrument (**1600**). Piercing element (**1620**) is also in a retracted state during this advancement of instrument (**1600**). Instrument (**1600**) is oriented such that transverse opening (**1610**) faces the posterior wall of the ethmoid bulla (EB). In some instances, this orientation is achieved through direct visualization. In some other instances, this orientation is achieved through complementary features of guide catheter (**1700**) and instrument (**1600**). For instance, such complementary features may operate on an assumption that the inner region of bend (**1704**) is oriented toward the ethmoid bulla (EB). The complementary features may include a visual indicator on guide catheter (**1700**) that is aligned with the inner region of bend (**1705**) and a visual indicator on catheter body (**1602**) that is aligned with transverse opening (**1610**), such that the operator may rotate catheter body (**1602**) relative to guide catheter (**1700**) until these visual indicators are aligned with each other. Alternatively, complementary notch and protrusion may mate when catheter body (**1602**) is properly oriented relative to guide catheter (**1700**). As yet another merely illustrative example, catheter body (**1602**) may be keyed to guide catheter (**1700**), providing a poka-yoke feature that ensures consistent alignment between transverse opening (**1610**) and the inner region of bend (**1704**). Other suitable features will be apparent to those of ordinary skill in the art in view of the teachings herein.

Once instrument (**1600**) has been suitably positioned, fluid source (**1632**) is actuated to drive fluid into balloons (**1606**, **1608**), thereby inflating balloons (**1606**, **1608**) as shown in FIG. **22**C (see also FIG. **21**B). In the present example, balloons (**1606**, **1608**) are only inflated with enough fluid pressure to provide structural support of catheter body (**1602**) in the retrobullar space (RBS). Balloons (**1606**, **1608**) are not inflated to the point where they remodel the retrobullar space (RBS) by fracturing the middle turbinate vertical basal lamella (MTvBL) or the posterior wall of the ethmoid bulla (EB). In some other instances, though, balloons (**1606**, **1608**) may in fact be inflated to the point where hey remodel the retrobullar space (RBS) by fracturing the middle turbinate vertical basal lamella (MTvBL) and/or the posterior wall of the ethmoid bulla (EB). Piercing element (**1620**) remains in the retracted position until balloons (**1606**, **1608**) are sufficiently inflated.

After balloons (**1606**, **1608**) have been sufficiently inflated, piercing element (**1620**) is advanced distally as shown in FIG. **22**D (see also FIG. **21**C). This drives tip (**1622**) along a generally transverse path such that tip (**1622**) pierces the posterior wall of the ethmoid bulla (EB). In some instances, a port or wick is deployed in the posterior wall of the ethmoid bulla (EB). In addition or in the alternative, the ethmoid bulla (EB) may be flushed with saline and suction through the opening formed by tip (**1622**). In the present example, however, piercing element (**1620**) is simply retracted proximally back into catheter body (**1602**), balloons (**1606**, **1608**) are deflated, and instrument (**1600**) and catheter (**1700**) are removed from the nasal cavity, leaving behind a newly formed passageway (P) in the posterior wall of the ethmoid bulla (EB). This newly formed passageway (P) provides improved fluid communication between the ethmoid bulla (EB) and the transition zone provided by the retrobullar space (RBS). While piercing element (**1622**) is used to form a new passageway (P) in this example, it should be understood that piercing element (**1622**) may instead be used to widen an existing ostium or passageway. For instance, piercing element (**1622**) may be used to widen a naturally occurring ostium or an ostium that has been created using an instrument.

FIG. **23** shows another exemplary instrument (**1800**) that may be used to pierce the posterior wall of the ethmoid bulla (EB). Instrument (**1800**) of this example comprises a catheter body (**1802**), a balloon (**1804**), and a plurality of spikes (**1806**) secured to a base (**1808**). Base (**1808**) is secured to balloon (**1804**) such that balloon (**1804**) will drive spikes (**1806**) outwardly when balloon (**1804**) is inflated, with base (**1808**) providing support for spikes (**1806**) over a substantial surface area of balloon (**1804**). Instrument (**1800**) may be used in place of instrument (**1600**) described above in order to create new ostia in the posterior wall of the ethmoid bulla (EB). In particular, instrument (**1800**) may be advanced through guide catheter (**1700**) while balloon (**1804**) is in a non-inflated state until balloon (**1804**) reaches the retrobullar space (RBS). Once balloon (**1804**) is in the retrobullar space (RBS) and spikes (**1806**) are pointed toward the posterior wall of the ethmoid bulla (EB), the balloon (**1804**) is inflated to drive spikes (**1806**) through the posterior wall of the ethmoid bulla (EB). Balloon (**1804**) is then deflated and instrument (**1800**) is removed with guide catheter (**1700**), leaving behind ostia formed by spikes (**1806**) in the posterior wall of the ethmoid bulla (EB). In some instances, balloon (**1804**) is inflated to a point where balloon (**1804**) remodels the retrobullar space (RBS) by fracturing the middle turbinate vertical basal lamella (MTvBL) or the posterior wall of the ethmoid bulla (EB), though this is of course merely optional.

FIG. **24** shows yet another exemplary instrument (**1900**) that may be used to pierce the posterior wall of the ethmoid bulla (EB). Instrument (**1900**) of this example comprises a guide catheter (**1910**) having a bend (**1912**) and an open distal end (**1914**). A secondary guide (**1920**) is slidably disposed in guide catheter (**1910**) and has another bend (**1922**) and an open distal end (**1924**). Secondary guide (**1920**) is resiliently biased to define bend (**1922**) but is configured to assume a straight configuration when retracted and confined within guide catheter (**1910**). A piercing element (**1930**) is slidably disposed in secondary guide (**1920**) and has a piercing tip (**1936**). Piercing element (**1930**) is flexible enough to slide along the paths formed by bends (**1912**, **1922**) yet has sufficient strength to pierce the posterior wall of the ethmoid bulla (EB). Bend (**1912**) spans approximately 90 degrees while bend (**1922**) also spans approximately 90 degrees, such that guide catheter (**1910**) and secondary guide (**1920**) together are configured to redirect piercing element (**1930**) approximately 180 degrees. This may enable piercing element (**1930**) to readily reach the posterior wall of the ethmoid bulla (EB). In addition to forming a new ostium in the ethmoid bulla (EB), it should be understood that instrument (**1900**) may also be used to enlarge an ostium that is already present. Such a pre-existing ostium may be a naturally occurring ostium or an ostium that was created by an instrument such as any of the piercing instruments (**1600**, **1800**, **1900**) described herein, etc. Piercing element (**1930**) and secondary guide (**1920**) may both be retracted relative to guide catheter (**1910**) during positioning of instrument (**1900**) in the patient and during removal of instrument (**1900**) from the patient.

While the foregoing examples are provided in the context of piercing a wall of the ethmoid bulla (EB), it should be understood that similar procedures may be performed elsewhere within the sinus complex, such as in the sphenoid sinus (SS), or in the posterior ethmoid sinus (PES). By way of example only, an instrument may be used to form an opening in the middle turbinate vertical basal lamella (MTvBL), medial to the posterior wall of the ethmoid bulla (EB) but lateral to the lateral wall of the vertical basal lamella (MTvBL). The formed opening may serve to increase ventilation to the posterior ethmoid sinus (PES) cells and allow patient-administered substances to reach the posterior ethmoid sinus (PES) cells. Various ways in which the above described procedures (and in some cases, instruments) may be modified to create ostia for sinus cells other than the ethmoid bulla (EB) will be apparent to those of ordinary skill in the art in view of the teachings herein.

VIII. Exemplary Additional Piercing Variations

As noted above, the wall defining a sinus cavity may be pierced for various purposes, including but not limited to deploying a port, deploying a wick, or simply creating a new ostium. Several examples of instruments that may be used to pierce the wall of a sinus cavity have been described above. It should be understood that sinus wall piercing elements may include trocar type tips, coring tips, and other types of tips. Such tips may be advanced without rotation, advanced with rotation (e.g., in full rotations or angularly reciprocating partial rotations), advanced with longitudinal reciprocation (e.g., in a jackhammering action), or advanced with both rotation and longitudinal reciprocation. Piercing tips may have a sharp edge and/or an abrasive edge. As used herein, the term "piercing" should be understood to include various forms of cutting. For instance, a piercing element may also be configured to cut a slice out of a sinus wall. This may include corner slicing, medial slicing, or other forms of slicing/cutting. In some instances an act of cutting leaves a mucosal flap that can cover over exposed bone. When a cut leaves exposed bone or a tattered tissue edge, the same may be covered with a conformal material and/or curing material. Additional examples of piercing/cutting elements will be described in greater detail below; while further examples will be apparent to those of ordinary skill in the art in view of the teachings herein.

FIG. **25** shows an exemplary piercing tip (**2000**) that may be used to form an opening in a sinus wall. Piercing tip (**2000**) of this example comprises a tubular portion (**2002**) with a plurality of sharp points (**2004**) angularly arrayed about its distal edge. Piercing tip (**2000**) may be rotated about its longitudinal axis while being advanced along its longitudinal axis to pierce a sinus wall. In some versions where piercing tip (**2000**) is used to pierce the wall of an ethmoid bulla (EB), piercing tip (**2000**) is advanced in the posterior direction. In some such versions, a back support (not shown) may be positioned within the retrobullar space (RBS). Such a support may be an integral feature of the instrument that includes piercing tip (**2000**) or may be part of a separate instrument. In addition or in the alternative, some exemplary uses may include first partially driving sharp points (**2004**) into the sinus wall without rotating piercing tip (**2000**) (e.g., stopping advancement as soon as sharp points (**2004**) have reached the bone), then subsequently initiating rotation and further advancement of piercing tip (**2000**) to complete the piercing process. Other suitable ways in which piercing tip (**2000**) may be used will be apparent to those of ordinary skill in the art in view of the teachings herein.

FIGS. **26**A-**26**C show another exemplary instrument (**2100**) that may be used to form an opening in a sinus wall (SW). The sinus wall (SW) may be a wall of the ethmoid bulla (EB) or the wall of some other sinus cavity. Instrument (**2100**) of this example comprises a tubular outer sheath (**2102**) with a distal opening (**2104**). In some versions, distal opening (**2104**) is defined by a sharp edge. Instrument (**2100**) further includes an inner coil member (**2106**) that has a corkscrew configuration. Inner coil member (**2106**) is operable to rotate and translate relative to outer sheath (**2102**). As shown in FIG. **26**A, instrument (**2100**) is positioned such that distal opening (**2104**) is located at the sinus wall (SW). Inner coil member (**2106**) is then driven through the sinus wall (SW) while outer sheath (**2102**) remains stationary, as shown in FIG. **26**B. In the present example, inner coil member (**2106**) rotates as it advances longitudinally. With the inner coil member (**2106**) disposed in the sinus wall (SW), instrument (**2100**) is then reciprocated longitudinally as shown in FIG. **26**C. In some versions, this reciprocation involves only coil member (**2106**), while outer sheath (**2102**) remains stationary. In some other versions, this reciprocation also involves outer sheath (**2102**), such that the distal edge defining distal opening (**2104**) is driven through sinus wall (SW). In either case, the reciprocation enlarges the initial opening formed by coil member (**2106**).

FIGS. **27**A-**27**C and **28**A-**28**C show another exemplary instrument (**2200**) that may be used to form an opening in a sinus wall (SW). The sinus wall (SW) may be a wall of the ethmoid bulla (EB) or the wall of some other sinus cavity. Instrument (**2200**) of this example comprises an elongate member (**2202**) having a curved distal end terminating in a sharp tip (**2204**). Instrument (**2200**) further comprises a cutting member (**2206**) that is slidably disposed about elongate member (**2202**). In the present example, cutting member (**2206**) has a sharp distal edge (**2208**) and a U-shaped profile. Distal edge (**2208**) further extends along at least part of the length of cutting member (**2206**) in the present example. Of course, cutting member (**2206**) may have various other configurations.

As shown in FIGS. **27**A and **28**A, instrument (**2200**) may be initially positioned such that tip (**2204**) is at a sinus wall (SW), with cutting member (**2206**) in a retracted position (retracted out of view in FIGS. **27**A and **28**A). Elongate member (**2202**) is then advanced through the sinus wall (SW), while cutting member (**2206**) remains in a retracted position. As shown in FIGS. **27**B and **28**B, tip (**2204**) has passed through the sinus wall (SW) twice due to the curved configuration of the distal end of elongate member (**2202**). Next, cutting member (**2206**) is advanced along elongate member (**2202**), while elongate member (**2202**) remains stationary, as shown in FIGS. **27**C and **28**C. Cutting member (**2206**) is configured to follow the curved path defined by the distal end of elongate member (**2202**); and is further configured to travel to a point where sharp distal edge (**2208**) is positioned by tip (**2204**). During this advancement, sharp distal edge (**2208**) cuts through the sinus wall (SW) twice. It should be understood that elongate member (**2202**) anchors instrument (**2200**) in the sinus wall (SW) and may further provide structural support to the sinus wall (SW) as cutting member (**2206**) traverses the sinus wall (SW). Instrument (**2200**) is then withdrawn from sinus wall (SW), leaving behind an opening (**2250**) as shown in FIGS. **27**D and **28**D. Various other suitable features of instrument (**2200**) and methods of using instrument (**2200**) will be apparent to those of ordinary skill in the art in view of the teachings herein.

FIGS. **29**A-**29**C and **30**A-**30**C show another exemplary instrument (**2300**) that may be used to form an opening in a sinus wall (SW). The sinus wall (SW) may be a wall of the ethmoid bulla (EB) or the wall of some other sinus cavity. Instrument (**2300**) of this example comprises an elongate shaft (**2302**) having a plurality of transversely extending sharp-tipped claw members (**2304**) at its distal end. In the present example, claw members (**2304**) are selectively retracted and extended relative to shaft (**2302**). Claw members (**2304**) are configured to extend and retract along curved paths, such that claw members (**2304**) on opposing sides of a longitudinally extending transverse plane extend toward each other in a grabbing action as claw members (**2304**) are advanced to extended positions. Various suitable ways in which claw members (**2304**) may be selectively retracted and extended relative to shaft (**2302**) will be apparent to those of ordinary skill in the art in view of the teachings herein.

As shown in FIGS. **29**A and **30**A, instrument (**2300**) may be initially positioned such that the distal end of shaft (**2302**) is at a sinus wall (SW) with claw members (**2304**) in retracted positions. Claw members (**2304**) are then extended into the sinus wall (SW) while shaft (**2302**) remains stationary, as shown in FIGS. **29**B and **30**B. With claw members (**2304**) disposed in the sinus wall (SW) and held in the extended position, shaft (**2302**) is then pulled away from the sinus wall (SW), along a path that is generally transverse to the longitudinal axis of shaft (**2302**), as shown in FIGS. **29**C and **30**C. This effectively tears away a portion of the sinus wall (SW) that was being grasped by claw members (**2304**), leaving behind an opening (**2350**) as shown in FIGS. **29**D and **30**D. In some versions, the base of each claw member (**2304**) may be formed into sharp blades extending between claw members (**2304**), thus allowing the target tissue to be sliced away from the remaining sinus wall (SW) rather than being torn, as claw members (**2304**) are closed into the positions shown in FIGS. **29**C and **30**C. Various other suitable features of instrument (**2300**) and methods of using instrument (**2300**) will be apparent to those of ordinary skill in the art in view of the teachings herein.

FIGS. **31**A-**31**E show another exemplary instrument (**2400**) that may be used to form an opening in a sinus wall (SW). The sinus wall (SW) may be a wall of the ethmoid bulla (EB) or the wall of some other sinus cavity. Instrument (**2400**) of this example comprises an outer cutting sheath (**2402**) and an inner auger member (**2410**). Outer cutting sheath (**2402**) comprises a tapered distal region (**2403**) terminating in an opening (**2404**) that is defined by a sharp annular edge. Auger member (**2410**) comprises a sharp distal tip (**2412**) and a helical thread (**2414**). Helical thread (**2414**) presents an effective outer diameter that increases along the length of auger member (**2410**). It should be understood that the depicted version of helical thread (**2414**) is merely illustrative; and that helical thread (**2414**) may have any suitable thread pitch. Auger member (**2410**) is operable to longitudinally advance distally relative to cutting sheath (**2402**) and also rotate relative to cutting sheath (**2402**).

As shown in FIG. **31**A, instrument (**2400**) may be initially positioned such that the distal end (**2404**) of cutting sheath (**2402**) is at a sinus wall (SW) with auger member (**2410**) retracted within cutting sheath (**2402**). Auger member (**2410**) is then advanced distally such that distal tip (**2412**) pierces the sinus wall (SW) as shown in FIG. **31**B. In some versions, auger member (**2410**) rotates during this advancement while in other versions it does not. After initially piercing the sinus wall (SW) with distal tip (**2412**), auger member (**2410**) continues to advance distally while rotating. This causes helical thread (**2414**) to drive through the sinus wall (SW) like an auger blade, as shown in FIG. **31**C. To this point, cutting sheath (**2402**) has remained stationary. However, cutting sheath (**2402**) now is advanced distally while auger member (**2410**) remains stationary. In some versions, sheath (**2402**) rotates while it advances distally; while in other versions it does not. When cutting sheath (**2402**) advances, the sharp edge defining opening (**2404**) passes through the sinus wall (SW) such that tapered region (**2403**) is initially disposed in the sinus wall (SW) as shown in FIG. **31**D. During this advancement of cutting sheath (**2402**), auger member (**2410**) anchors instrument (**2400**) in the sinus wall (SW) and may further provide structural support to the sinus wall (SW) as cutting sheath (**2402**) traverses the sinus wall (SW). Sheath (**2402**) continues to advance distally (either with or without rotation) while auger member (**2410**) remains stationary, until tapered region (**2403**) has fully traversed the sinus wall (SW) as shown in FIG. **31**E. Tapered region (**2403**) thus provides a gradual widening of the opening in the sinus wall (SW). Instrument (**2400**) is then withdrawn from sinus wall (SW), leaving behind an opening (**2450**) as shown in FIG. **31**F. It should be understood that auger member (**2410**) and/or sheath (**2402**) may be driven to any depth desired. For instance, auger member (**2410**) and sheath (**2402**) may be driven through two or more sinus walls (SW) (e.g., along the same longitudinal path). Various other suitable features of instrument (**2400**) and methods of using instrument (**2400**) will be apparent to those of ordinary skill in the art in view of the teachings herein.

FIGS. **32**A-**32**B show an exemplary instrument (**2500**) that may be used to form openings in two sinus walls (SW) on opposite sides of the nasal septum (NS) substantially simultaneously. In the present example, the sinus walls (SW) are medial walls of the ethmoid bullae (EB), though it should be understood that instrument (**2500**) may be used on other sinus walls (SW). Instrument (**2500**) of this example comprises a shaft (**2502**) having a pair of longitudinally extending arms (**2504**). The distal end of each arm (**2504**) includes an outwardly extending piercing element (**2506**). While piercing elements (**2506**) are shown as spikes in the present example, it should be understood that piercing elements (**2506**) may have various other suitable configurations as will be apparent to those of ordinary skill in the art in view of the teachings herein. For instance, piercing elements (**2506**) may be selectively retractable relative to arms (**2504**) (e.g., similar to piercing element (**1620**) of instrument (**1600**) described above).

Instrument (**2500**) is operable to move arms (**2504**) laterally outwardly from a first position to a second position. In particular, as shown in FIG. **32**A, arms (**2504**) are positioned such that piercing elements (**2506**) are medial to the sinus walls (SW) when arms (**2504**) are in the first position. It should be understood that arms (**2504**) are spaced such that arms (**2504**) may be simultaneously inserted into respective nostrils when arms (**2504**) are in the first position. As shown in FIG. **32**B, arms (**2504**) drive piercing elements (**2506**) laterally into the sinus walls (SW) when arms (**2504**) are moved to the second position. The sinus walls (SW) may provide inwardly directed counteracting forces on arms (**2504**) as arms (**2504**) simultaneously move to the second position. In some other versions, arms (**2504**) are actuated independently/unilaterally. In some such versions, the stationary arm (**2504**) bears against the lateral wall of the middle turbinate (MT) for support; while the other arm (**2504**) is actuated to drive piercing element (**2506**) into the sinus wall (SW). Arms (**2504**) may be actuated manually by a mechanical linkage, by direct application of the operator's hand force, by hydraulic/pneumatic means such as a balloon, and/or in any other suitable fashion. In some versions, piercing elements (**2506**) are replaced with atraumatic tissue contact features (e.g., pads) that are pressed against the sinus walls (SW) to deform the sinus walls and thereby remodel a portion of the paranasal cavity. Various other suitable features of instrument (**2500**) and methods of using instrument (**2500**) will be apparent to those of ordinary skill in the art in view of the teachings herein.

In any of the foregoing examples of sinus wall piercing (among other examples), it may be desirable to provide some form of structural support to the sinus wall during interaction between the sinus wall and the instrument, to reduce the risk of the sinus wall shattering to an undesirable degree during such interaction. As noted above with respect to instruments (**2200**, **2400**), such support may be provided by the instrument itself. While curved elongate member (**2202**) and auger member (**2410**) were used in the examples above, other instrument features that may be used to provide structural support to a sinus wall during piercing will be apparent to those of ordinary skill in the art in view of the teachings herein.

In some other versions, a support material may be introduced into the sinus cavity before the act of piercing with an instrument, again to reduce the risk of the sinus wall shattering to an undesirable degree during piercing/cutting of the sinus wall. By way of example only, such support material may include a sand-like material or a hardening liquid. For instance, a hardening polymer fluid may be introduced into the sinus cavity before the act of piercing with an instrument; and may then be removed after the sinus wall has been pierced. As another merely illustrative example, a hardening biocompatible liquid may be removed with irrigation fluid once the sinus wall has been opened with a piercing element. As yet another merely illustrative example, a material that dissolves through bioabsorption or through some other process (dissolving either shortly after the sinus wall has been pierced or some time thereafter) may be used. Other examples of support material will be apparent to those of ordinary skill in the art in view of the teachings herein. Likewise, various suitable ways in which support material may be introduced to the sinus cavity will be apparent to those of ordinary skill in the art in view of the teachings herein.

In addition to or in lieu of providing a support material, the sinus wall may be frozen in order to add structural integrity to the sinus wall. By way of example only, such freezing may be provided through an applicator that is kept cold; or by the injection of a cold liquid (e.g., liquid nitrogen, etc.). As yet another alternative to providing a support material, an instrument may rely on the inertia of the sinus wall to effectively provide structural integrity. For instance, the tip of the piercing element may be advanced (and perhaps also rotated) at such a rapid rate that the inertia of the sinus wall acts as a support.

IX. Miscellaneous

It should be understood that any of the examples described herein may include various other features in addition to or in lieu of those described above. By way of example only, any of the examples described herein may also include one or more of the various features disclosed in any of the various references that are incorporated by reference herein.

It should be understood that any one or more of the teachings, expressions, embodiments, examples, etc. described herein may be combined with any one or more of the other teachings, expressions, embodiments, examples, etc. that are described herein. The above-described teachings, expressions, embodiments, examples, etc. should therefore not be viewed in isolation relative to each other. Various suitable ways in which the teachings herein may be combined will be readily apparent to those of ordinary skill in the art in view of the teachings herein. Such modifications and variations are intended to be included within the scope of the claims.

It should be appreciated that any patent, publication, or other disclosure material, in whole or in part, that is said to be incorporated by reference herein is incorporated herein only to the extent that the incorporated material does not conflict with existing definitions, statements, or other disclosure material set forth in this disclosure. As such, and to the extent necessary, the disclosure as explicitly set forth herein supersedes any conflicting material incorporated herein by reference. Any material, or portion thereof, that is said to be incorporated by reference herein, but which conflicts with existing definitions, statements, or other disclosure material set forth herein will only be incorporated to the extent that no conflict arises between that incorporated material and the existing disclosure material.

Versions described above may be designed to be disposed of after a single use, or they can be designed to be used multiple times. Versions may, in either or both cases, be reconditioned for reuse after at least one use. Reconditioning may include any combination of the steps of disassembly of the device, followed by cleaning or replacement of particular pieces, and subsequent reassembly. In particular, some versions of the device may be disassembled, and any number of the particular pieces or parts of the device may be selectively replaced or removed in any combination. Upon cleaning and/or replacement of particular parts, some versions of the device may be reassembled for subsequent use either at a reconditioning facility, or by a user immediately prior to a procedure. Those skilled in the art will appreciate that reconditioning of a device may utilize a variety of techniques for disassembly, cleaning/replacement, and reassembly. Use of such techniques, and the resulting reconditioned device, are all within the scope of the present application.

By way of example only, versions described herein may be sterilized before and/or after a procedure. In one sterilization technique, the device is placed in a closed and sealed container, such as a plastic or TYVEK bag. The container and device may then be placed in a field of radiation that can penetrate the container, such as gamma radiation, x-rays, or high-energy electrons. The radiation may kill bacteria on the device and in the container. The sterilized device may then be stored in the sterile container for later use. A device may also be sterilized using any other technique known in the art, including but not limited to beta or gamma radiation, ethylene oxide, or steam.

Having shown and described various embodiments of the present invention, further adaptations of the methods and systems described herein may be accomplished by appropriate modifications by one of ordinary skill in the art without departing from the scope of the present invention. Several of such potential modifications have been mentioned, and others will be apparent to those skilled in the art. For instance, the examples, embodiments, geometrics, materials, dimensions, ratios, steps, and the like discussed above are illustrative and are not required. Accordingly, the scope of the present invention should be considered in terms of the following claims and is understood not to be limited to the details of structure and operation shown and described in the specification and drawings.

We claim:

1. A method of treating a sinus cavity, the method comprising

(a) piercing at least one wall of the sinus cavity to form an opening, wherein the act of piercing at least one wall of the sinus cavity comprises:

(i) piercing the sinus cavity in a first wall location, and

(ii) piercing the sinus cavity in a second wall location;

(b) inserting a fluid transfer member through the opening in the at least one wall of the sinus cavity, wherein the fluid transfer member comprises a first port, a second port, and a wick defining a fluid passageway and wherein the fluid transfer member is configured to provide a direct fluid communication path between the interior of the sinus cavity and a region external to the sinus cavity, wherein a portion of fluid transfer member extends into the interior of the sinus cavity, wherein the portion of the at least one fluid transfer member extending into the interior of the sinus cavity is longer than a portion disposed in the opening of the sinus cavity, wherein the wick is configured to transfer fluid medication through a capillary action and to administer the fluid medication directly from the wick to mucosa in the sinus cavity, wherein the act of inserting the fluid transfer member comprises:

(i) inserting the first port into the first wall location, and

(ii) inserting the second port into the second wall location so that the first port and the second port are in direct fluid communication with one another via the wick; and

(c) administering the fluid medication into a nostril in such a way that the fluid medication travels along the fluid transfer member by way of a capillary action, and is administered directly from the wick to mucosa in the sinus cavity by the wick extending into the interior of the sinus cavity.

2. The method of claim **1**, wherein the sinus cavity comprises an ethmoid sinus cell.

3. The method of claim **2**, wherein the sinus cavity comprises an ethmoid bulla.

4. The method of claim **1**, wherein the first wall location provides a path to an anterior space within the paranasal cavity, wherein the second wall location provides a path to an adjacent sinus cavity.

5. The method of claim **1**, wherein the first port has at least one outwardly extending retention feature configured to engage a wall of the sinus cavity.

6. The method of claim **1**, wherein the fluid transfer member comprises a bioabsorbable material.

7. The method of claim **1** comprising the step of creating a passageway in an ethmoid sinus, by:

(a) positioning a piercing element adjacent to the middle turbinate vertical basal lamella; and

(b) piercing the middle turbinate vertical basal lamella, wherein the act of piercing the middle turbinate vertical basal lamella comprises driving the piercing element into the middle turbinate vertical basal lamella, thereby creating a passageway in the posterior wall of the middle turbinate vertical basal lamella.

8. A method of treating a sinus cavity, the method comprising

(a) piercing two walls of the sinus cavity to form an opening in both walls;

(b) inserting a fluid transfer member through the opening in the two walls of the sinus cavity, wherein the fluid transfer member comprises a first port, a second port, and a wick defining a fluid passageway and wherein the fluid transfer member is configured to provide a direct fluid communication path between the interior of the sinus cavity and a region external to the sinus cavity, wherein the wick extends into the interior of the sinus cavity, wherein the first port is disposed in the opening of a first wall of the two walls, wherein the second port is disposed in the opening of a second wall of the two walls, wherein the wick provides direct fluid communication between the first port and the second port, wherein a portion of the fluid transfer member extending into the interior of the sinus cavity is longer than a portion disposed in the opening of the sinus cavity, wherein the wick is configured to transfer fluid medication through a capillary action and to administer the fluid medication directly from the wick to mucosa in the sinus cavity; and

(c) administering the fluid medication into a nostril in such a way that the fluid medication travels along the fluid transfer member by way of a capillary action, and is administered directly from the wick to mucosa in the sinus cavity by the fluid transfer member extending into the interior of the sinus cavity.

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